15 YEARS

BYTE

APRIL 1990

A McGRAW-HILL PUBLICATION

Bonus European Editorial Section FOLLOWS PAGE 52

THE NEW

OS/2

Good-bye, DOS-in-a-Box
Hello, True 32-bit Power!

PAGE 119

Apple redefines top of the line with the 40-MHz

Mac IIfx

New IBM RISCs

Lotus 1-2-3/G

Toshiba T1200XE

Mylex EISA Triple Play

Emerging Architectures: IBM's SAA, DEC's NAS, Others

REVIEWS

23 386-Clone Motherboards

NEC Prospeed CSX

Low-Cost Color Scanner

HP NewWave

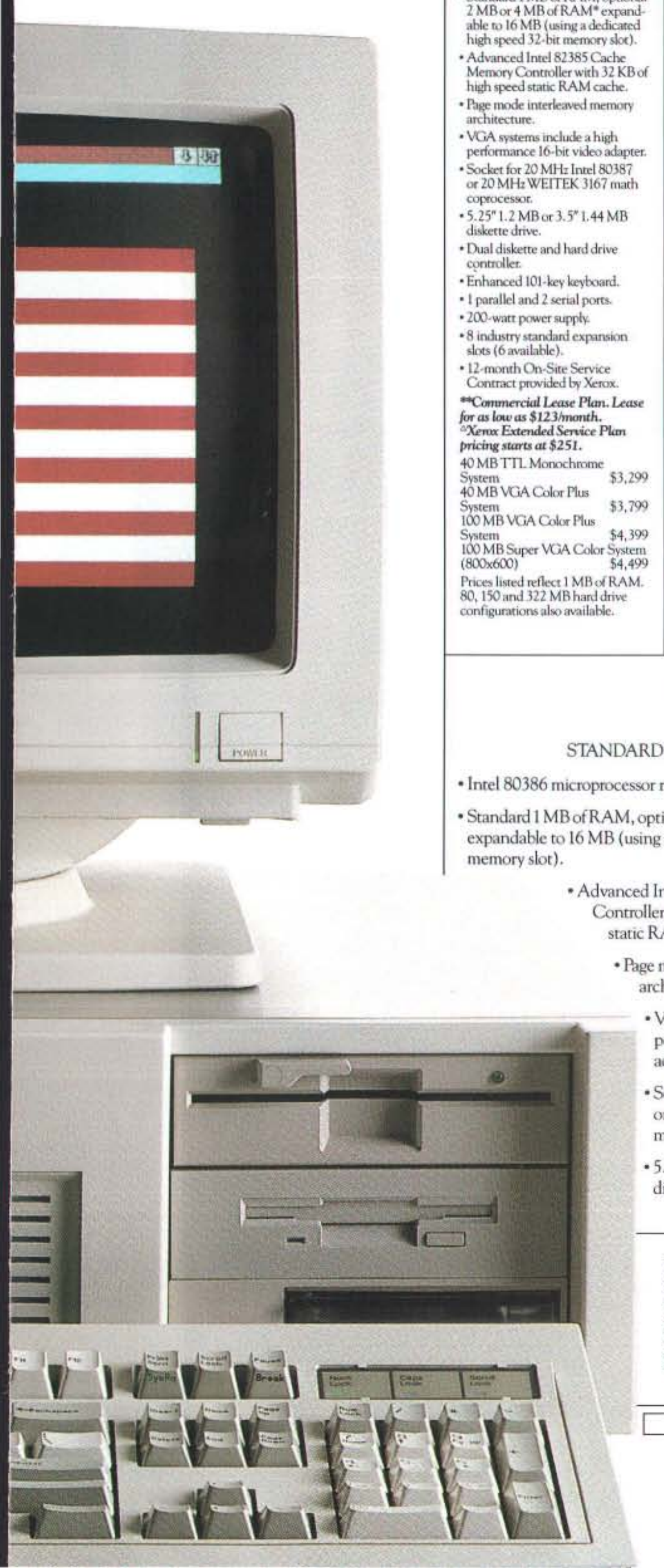
Amí Pro vs. Windows Word vs. Legend

FoxPro

MPW C++ vs. Think C 4.0

£1.95 U.K./A $6.50 AUSTRALIA
Lit. 8,000 ITALY/$3.50 U.S.A.
0360-5280

S OF
ER.



PC MAGAZINE EDITORS' CHOICE 11-29-88

THE DELL SYSTEM® 310
20 MHz 386.

The best combination of performance and value in its class.

STANDARD FEATURES:
- Intel 80386 microprocessor running at 20 MHz.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 20 MHz Intel 80387 or 20 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).
- 12-month On-Site Service Contract provided by Xerox.

Commercial Lease Plan. Lease for as low as $123/month.
△Xerox Extended Service Plan pricing starts at $251.

40 MB TTL Monochrome System	$3,299
40 MB VGA Color Plus System	$3,799
100 MB VGA Color Plus System	$4,399
100 MB Super VGA Color System (800x600)	$4,499

Prices listed reflect 1 MB of RAM. 80, 150 and 322 MB hard drive configurations also available.

THE DELL SYSTEM® 316SX
16 MHz 386SX.

The perfect low profile mainstream computer, combining 386SX power and compatibility with unprecedented value and support.

STANDARD FEATURES:
- Intel 80386SX microprocessor running at 16 MHz.
- Standard 512 KB of RAM, optional 640 KB, 1 MB or 2 MB of RAM* expandable to 16 MB (8 MB on system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 640 KB.
- Integrated diskette and high performance 16-bit VGA video controller on system board.
- Socket for Intel 80387SX math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high performance hard disk interface on system board.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 3 full-sized 16-bit AT expansion slots available.
- 12-month On-Site Service Contract provided by Xerox.

Commercial Lease Plan. Lease for as low as $72/month.
△Xerox Extended Service Plan pricing starts at $187.

20 MB VGA Monochrome System	$1,899
40 MB VGA Color Plus System	$2,399
40 MB Super VGA System (800x600)	$2,499
100 MB Super VGA System (800x600)	$3,099

Prices reflect 512 KB of RAM. 640 KB versions of the above systems are available for an additional $50, 1 MB versions for an additional $150, and 2 MB versions for an additional $300.
80 and 170 MB configurations also available.

THE NEW
DELL SYSTEM® 316LT
16 MHz 386SX.

This new full-featured, battery powered 386SX laptop costs less than most 286 laptops.

STANDARD FEATURES:
- Intel 80386SX microprocessor running at 16 MHz.
- Standard 1 MB of RAM, optional 2 MB of RAM* expandable to 8 MB (on the system board using 1 MB SIMMs).
- LIM 4.0 support for memory over 1 MB.
- Adjustable and detachable 640 x 480 VGA Liquid Crystal Display.
- One industry standard half-size 8-bit expansion slot.
- Socket for 16 MHz Intel 80387SX math coprocessor.
- 3.5" 1.44 MB diskette drive.
- 83-key keyboard with embedded numeric keypad and separate cursor control keys.
- 1 parallel, 1 serial, and external VGA monitor port.
- Connector for 101-key keyboard or numeric keypad.
- Two Removable and rechargeable NiCad battery packs utilizing Dell's "Continuous Power Battery System" (patent pending).
- AC Adapter.
- 12-month On-Site Service Contract provided by Xerox.

Commercial Lease Plan. Lease for as low as $127/month.
△Xerox Extended Service Plan pricing starts at $300.

20 MB, 1 MB RAM	$3,499
20 MB, 2 MB RAM	$3,699
40 MB, 1 MB RAM	$3,799
40 MB, 2 MB RAM	$3,999

PC WORLD BEST BUY

THE DELL SYSTEM® 210
12.5 MHz 286.

The price says this is an entry-level system. The performance says it's a lot more.

STANDARD FEATURES:
- 80286 microprocessor 12.5 MHz.
- Standard 512 KB of RAM, optional 640 KB, 1 MB or 2 MB of RAM* expandable to 16 MB (6 MB on the system board).
- Page mode interleaved memory architecture.
- LIM 4.0 support for memory over 640 KB.
- Integrated diskette and high performance 16-bit VGA video controller on system board.
- Socket for Intel 80287 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Integrated high pefomance hard disk interface on system board.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 3 full-sized 16-bit AT expansion slots available.
- 12-month On-Site Service Contract provided by Xerox.

Commercial Lease Plan. Lease for as low as $61/month.
△Xerox Extended Service Plan pricing starts at $158.

20 MB VGA Monochrome System	$1,599
20 MB VGA Color Plus System	$1,899
40 MB VGA Monochrome System	$1,799
40 MB VGA Color Plus System	$2,099

Prices listed reflect 512 KB of RAM. 640 KB versions of the above systems are available for an additional $50, 1 MB versions for an additional $150, and 2 MB versions for an additional $300.
80 and 100 MB hard drive configurations also available.

THE DELL SYSTEM® 325 25 MHz 386.

An even better value at these low prices.

STANDARD FEATURES:
- Intel 80386 microprocessor running at 25 MHz.
- Standard 1 MB of RAM, optional 2 MB or 4 MB of RAM* expandable to 16 MB (using a dedicated high speed 32-bit memory slot).
- Advanced Intel 82385 Cache Memory Controller with 32 KB of high speed static RAM cache.
- Page mode interleaved memory architecture.
- VGA systems include a high performance 16-bit video adapter.
- Socket for 25 MHz Intel 80387 or 25 MHz WEITEK 3167 math coprocessor.
- 5.25" 1.2 MB or 3.5" 1.44 MB diskette drive.
- Dual diskette and hard drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200-watt power supply.
- 8 industry standard expansion slots (6 available).
- 12-month On-Site Service Contract provided by Xerox.

Commercial Lease Plan. Lease for as low as $153/month.
△Xerox Extended Service Plan pricing starts at $370.

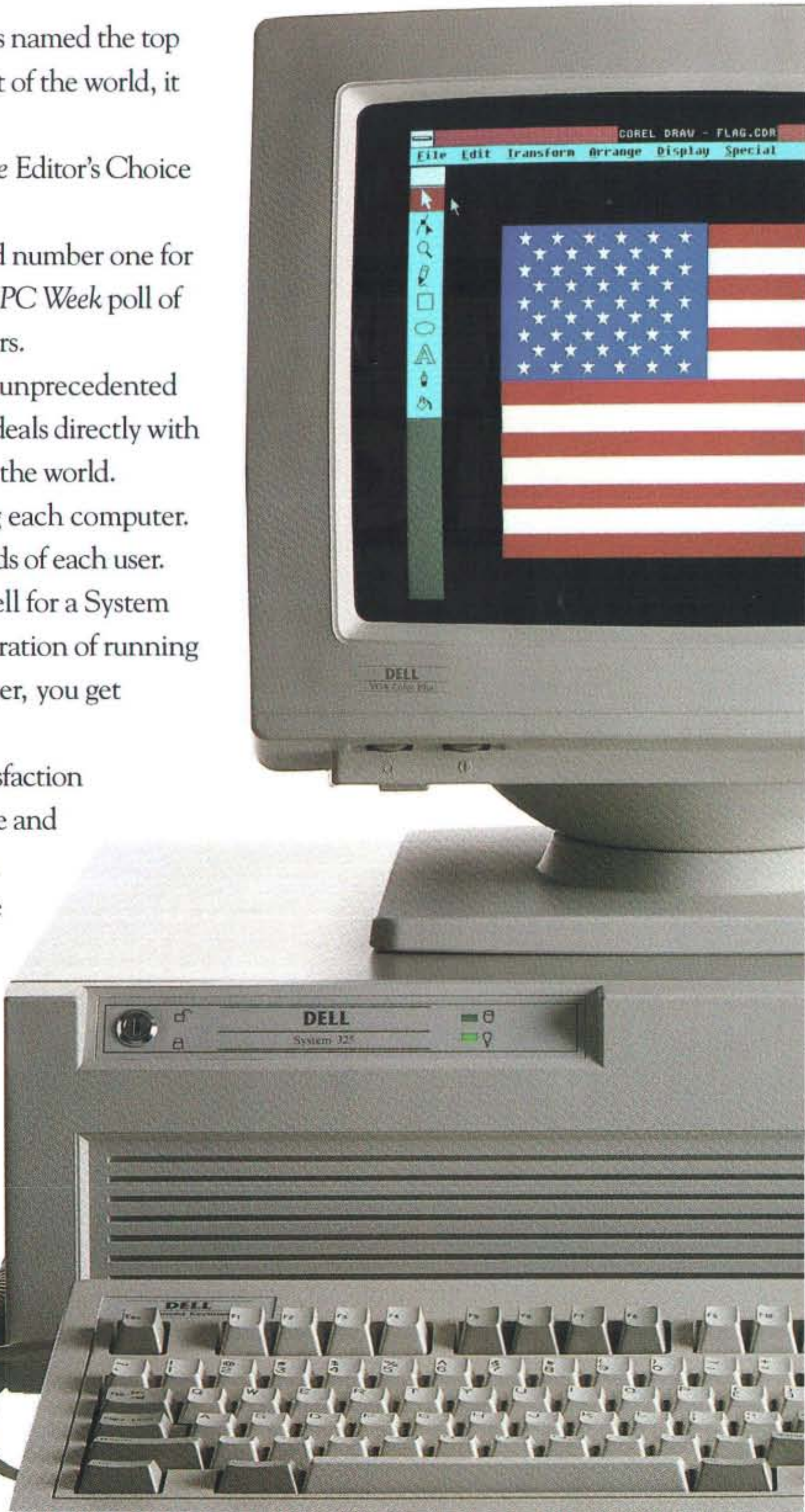
40 MB VGA Monochrome System	$4,199
100 MB VGA Color Plus System	$5,099
100 MB Super VGA Color System (800x600)	$5,199
150 MB Super VGA Color System (800x600)	$5,699

Prices listed reflect 1 MB of RAM. 80, 150 and 322 MB hard drive configurations also available.

Ask about our high resolution graphics.

***Performance Enhancements: Within the first megabyte of memory, 128 KB (316SX, 316LT and 210), 384 KB (325 and 310) of memory is reserved for use by the system to enhance performance. Can be optionally disabled on 316SX and 210. 4 MB configurations available on all systems. Call for pricing.** All systems are photographed with optional extras. All prices and specifications are subject to change without notice. Dell cannot be responsible for errors in typography or photography. **Payment based on 36-month, open-end lease. Leasing arranged by Leasing Group, Inc. In Canada, configurations and prices may vary. DELL SYSTEM is a registered trademark of Dell Computer Corporation. Intel is a registered trademark and 386 is a trademark of Intel Corporation. Other trademarks and trade names are used to identify the entities claiming the marks and names or their products. Dell Computer Corporation disclaims any proprietary interest in trademarks and trade names other than its own. △On-site service may not be available in certain locations.

AD CODE 11 E13


COREL DRAW - FLAG.CDR
File Edit Transform Arrange Display Special
DELL
DELL
System 325

THESE COUNTRIES JUST GOT TOGETHER AND ELECTED A NEW LEADER.

When computer publications from nine countries got together and voted for the best 386™ computer, it marked a major shift in power.

They chose the Dell System® 325 head and shoulders over every other system in the world.

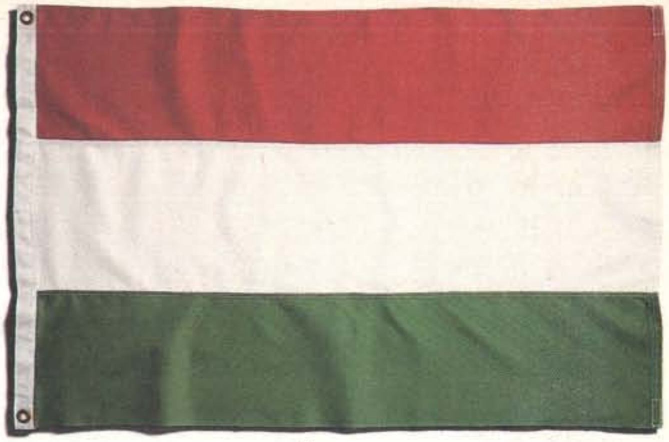
Turn the page and find out why.

800-283-1170

DELL COMPUTER CORPORATION

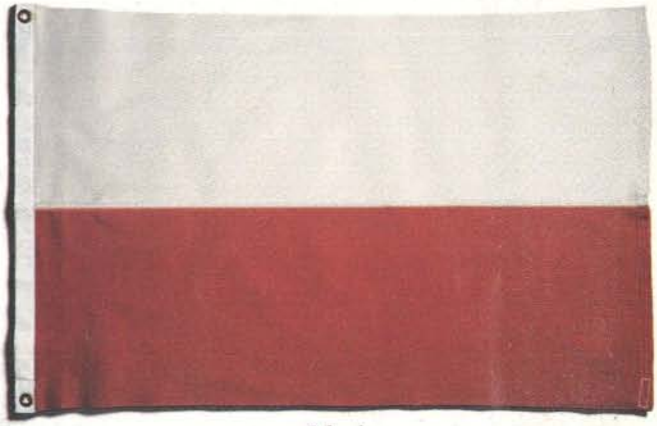
FOR NETWORK OR UNIX INFORMATION, CALL 800-678-UNIX.
For Dell in Canada, call 800-387-5752.

Germany

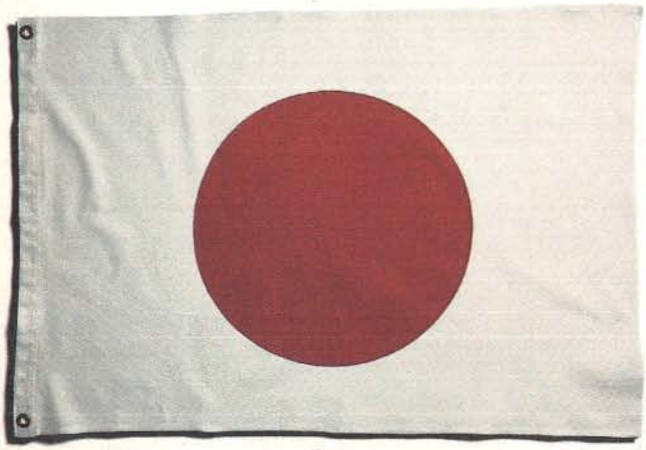


Hungary

Yugoslavia



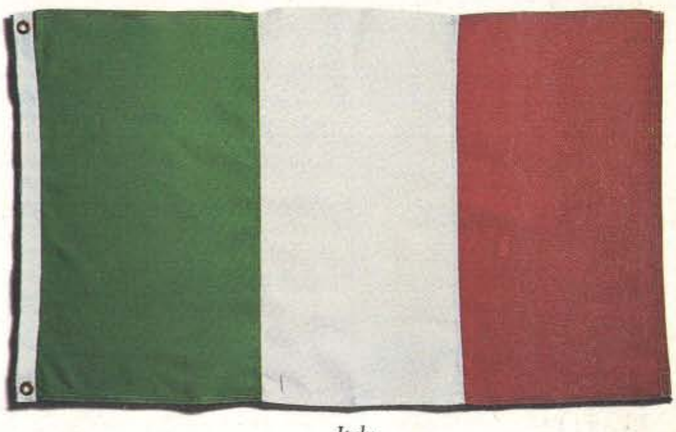
Poland



Japan

United Kingdom

Spain



Italy

power Cache 4... The most advanced What else would you expect

PC MAGAZINE, *January 1989,*
"In a field of powerhouse machines there can only be one winner, and ALR's FlexCache is it."

INFO WORLD, *July 1989,*
"ALR Systems Unleash 486 Power. The PowerCache 4 shines in the CPU-specific portion of the InfoWorld Automated Benchmark Test, gaining a score of 16.3."

PC WEEK, *July 1989,*
"Based on a series of benchmarks run last week on Advanced Logic Research, Inc.'s prototype 486 desktop system, ALR will enter the 486 market with a bang."

At ALR, we will never rest on our laurels. We strive to be the best, as proven by our past achievements. Now with the introduction of the new ALR PowerCache 4™, we've designed a system that is far beyond comparison. Again, we have taken PC-microprocessing power a step further by designing a unique proprietary PowerCache 4 cache controller using ALR's custom ASIC chips which deliver the fastest processing speed ever.

More important, PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing a better than zero wait state performance as compared to the i386. Furthermore, the ALR PowerCache 4 is 100% IBM® PS/2™ Micro Channel™-compatible supporting bus mastering devices and giving

	ALR M130 Desktop	**ALR M150, M350 M650 Floor-Standing**	**IBM M70-A21 Power Platform™**
CPU	25 MHz i486	25 MHz i486	25 MHz i486
Bus	MCA	MCA	MCA
External Cache	128 KB cache Read and Write-Back	128 KB cache Read and Write-Back	None
Video Opt. on board	640x480 1024x768	640x480 1024x768	640x480 None
I/O Slots	6 expansion slots	6 expansion slots	3 expansion slots
Storage Expansion	4-3 1/2"	1-full height 2-1/2"-height 2-3 1/2" drives	3-3 1/2" drives
Disk Capacity	130 MB-260 MB	150 MB-650 MB	110 MB
Price	$9,990	Starting at $11,490	$12,990

California Anza-Borrego Desert State Park

(Cannonball-shaped sandstone. These concretions are formed of onion-skin layers of minerals resistant to erosion.)

i486™ system in the world. from the leader in 386™ technology.

you a more efficient system for a variety of multi-user and fileserver applications. Like most ALR computers, the PowerCache 4 is a truly balanced system. The fastest power is achieved by enhancing our PowerCache 4 design with the industry's fastest disk drives and interface. The PowerCache 4 systems come standard with a high-speed 15MHz ESDI and 32 KB hard disk cache on the disk controller. What more could you possibly need.

It's no wonder ALR remains ahead of the pack with our innovative design expertise. As far back as 1986, we've been recognized in the industry as a leader in performance. Recently, the highly acclaimed 386/220 won us "Best of 1987" from *PC Magazine*. 1988 brought us the honor of receiving the *PC Magazine* Award for Technical Excellence for designing the industry's most advanced cache architecture. As for 1989 we've already begun to excite the industry with the PowerCache 4.

Now, what else would you expect from a company who is so committed to innovation and high-performance technology that we take you a step beyond. At ALR, we are concerned with your processing needs. Our technical support staff is available to assist you by one simple phone call. All our systems are backed by a one year warranty. Call today for more information on the new PowerCache 4 and the name of an authorized reseller nearest you.

1-800-444-4ALR

PowerCache 4 is the first PC to fully utilize 128-bit burst mode and a "read and write-back" 128KB cache design, providing better than zero wait state performance as compared to the i386.

California

Home of the World's First 386 PC
Advanced Logic Research Inc.

Advanced Logic Research, Inc.
9401 Jeronimo Irvine, CA 92718
(714) 581-6770 FAX: (714) 581-9240
For our Canadian office:
1-800-443-4CAN
For our UK office:
0 635-521 922 FAX: 0 635-521 844
For our Singapore:
(65) 258-1286 FAX: (65) 258-1285

BYTE

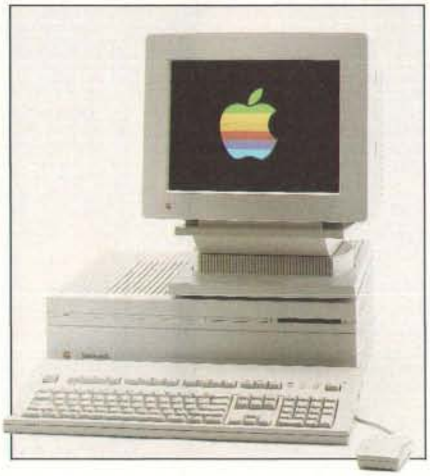
CONTENTS

April 1990
Volume 15, Number 4

COVER STORY

Apple's Special fx
page 111

Apple redefines top-of-the-line with the speedy IIfx.



NEWS

FIRST IMPRESSIONS

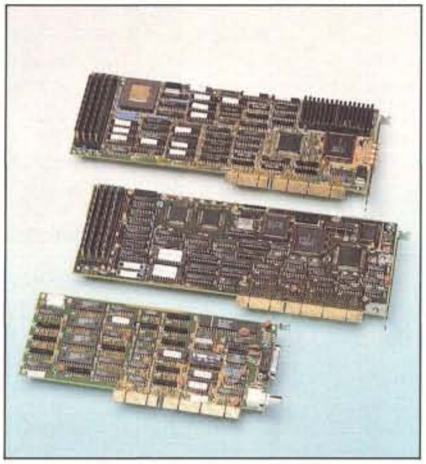
REVIEWS

STATE OF THE ART

EUROPE AND WORLD
begins after page 52

Time and Money/252

Editorial/10



FEATURES

HANDS ON

DEPARTMENTS

PERSPECTIVES

READER SERVICE

PROGRAM LISTINGS

From BIX: See **284**
From BYTEnet: call (617) 861-9764
On disk: See card after **336**

EXPERT ADVICE

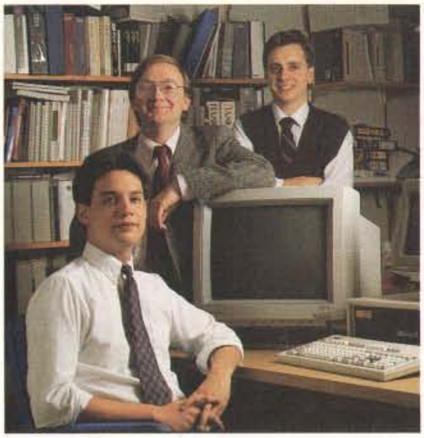
BYTE (ISSN 0360-5280/90) is published monthly with an additional issue in October by McGraw-Hill, Inc. U.S. subscriber rate $29.95 per year. In Canada and Mexico, $31.95 per year. Single copies $3.50 in the U.S., $3.95 in Canada. Executive, Editorial, Circulation and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba. Registration number 9321. Printed in the United States of America. **Postmaster:** Send address changes, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, P.O. Box 551, Hightstown, NJ 08520.

S P O T L I G H T

Rob Mitchell

Stan Wszola

Steve Apiki



From Math Chip to Tie Clip

The trials and tribulations of testing 25-MHz 386-based motherboards

At first, it seemed simple: Set up a standard system configuration that would let us plug in and benchmark 25-MHz 386-based motherboards. We would run both MS-DOS and Unix tests, compare features and price, and assess expandability. In the end, we accomplished our goal: to tell you which motherboards make the best PC clones (see "The Heart and Soul of a PC Compatible" on page 130). Our mistake was thinking that it would be easy.

Technical editor Rob Mitchell and testing editors Steve Apiki and Stan Wszola wrestled with one problem after another. The PC market is changing as fast as the technology. Consequently, several vendors revised their motherboards in the midst of the review, forcing us to duplicate work already done.

Not every vendor supplied a math coprocessor, so the BYTE Lab had to install one 25-MHz 80387 chip into a number of machines. While we placed the math chip in a special carrier to minimize wear and tear, and used special chip-pulling tools, by the end of testing we had somehow cracked the math chip, making it into the most expensive tie clip BYTE has ever purchased.

Assembling and disassembling systems from the ground up was more time-consuming than we had expected and brought more than a few surprises. Several boards failed, some spectacularly, when powered up in the BYTE Lab. One failure trashed the hard disk drive containing our Unix benchmark code.

We wanted to look at motherboards available through dealers and distributors for those of you who want to build or upgrade a machine yourselves. We also wanted products that you can't buy directly, but that you are likely to find in popular PC clones. Sorting out how each company markets its motherboards required a great deal of phone work.

But if you find any part of our effort useful when you shop for your next PC clone, we'll consider it work well done.

—Michael Nadeau

PHOTOGRAPHY: PAUL AVIS © 1990

Integrated Software for Schematics & PCB Artwork

Introducing HiWIRE®-Plus

Wintek's smARTWORK® pioneered low-cost printed-circuit-board CAD. Then HiWIRE set the standard for productivity and ease-of-use in schematic capture. Now Wintek introduces HiWIRE-Plus, integrating HiWIRE's schematic features with a powerful printed-circuit-design facility.

Creating Schematics

With HiWIRE-Plus, simply connect library symbols with wires and buses. Creating and changing symbols is fast and painless. Produce your drawing using a dot-matrix printer, laser printer, or pen plotter.

Circuit-Board Design

HiWIRE-Plus gives you all the design freedom you want: you choose the grid size, trace widths, and pad shapes. The board size and number of layers are virtually unlimited. HiWIRE-Plus is perfect for surface-mount, microstrip, and ECL applications.

Current Versions	
HiWIRE-Plus	V 1.3r0
smARTWORK	V 1.4r6

HiWIRE-Plus Advantages

- ☐ One tool for schematics and printed-circuit artwork
- ☐ Easy-to-learn menu-driven operation; complete documentation and tutorial
- ☐ Schematic libraries with TTL, CMOS, ECL, ladder, microprocessor, and discrete components
- ☐ Netlist and bill-of-materials utilities included
- ☐ Circuit boards up to 60x60 inches and 256 layers
- ☐ Variable grid size, trace width, and pad size (.001″ resolution)
- ☐ PCB library with DIPs, SIPs, SMDs, PGAs, TOs, and edge and D connectors
- ☐ Schematic-to-layout cross-checking
- ☐ Design-rule checker
- ☐ 800 number for free support

WINTEK®

"HiWIRE", "smARTWORK", "Wintek", and the Wintek logo are registered trademarks of Wintek Corporation.

System Requirements

- ☐ IBM PC, XT, AT, or PS/2 with 512K RAM, printer port, color monitor, and CGA, EGA, or VGA graphics card
- ☐ Microsoft Mouse
- ☐ IBM ProPrinter or Epson dot-matrix printer, and/or
- ☐ Houston Instrument or Hewlett-Packard pen plotter

Higher Performance Better Value

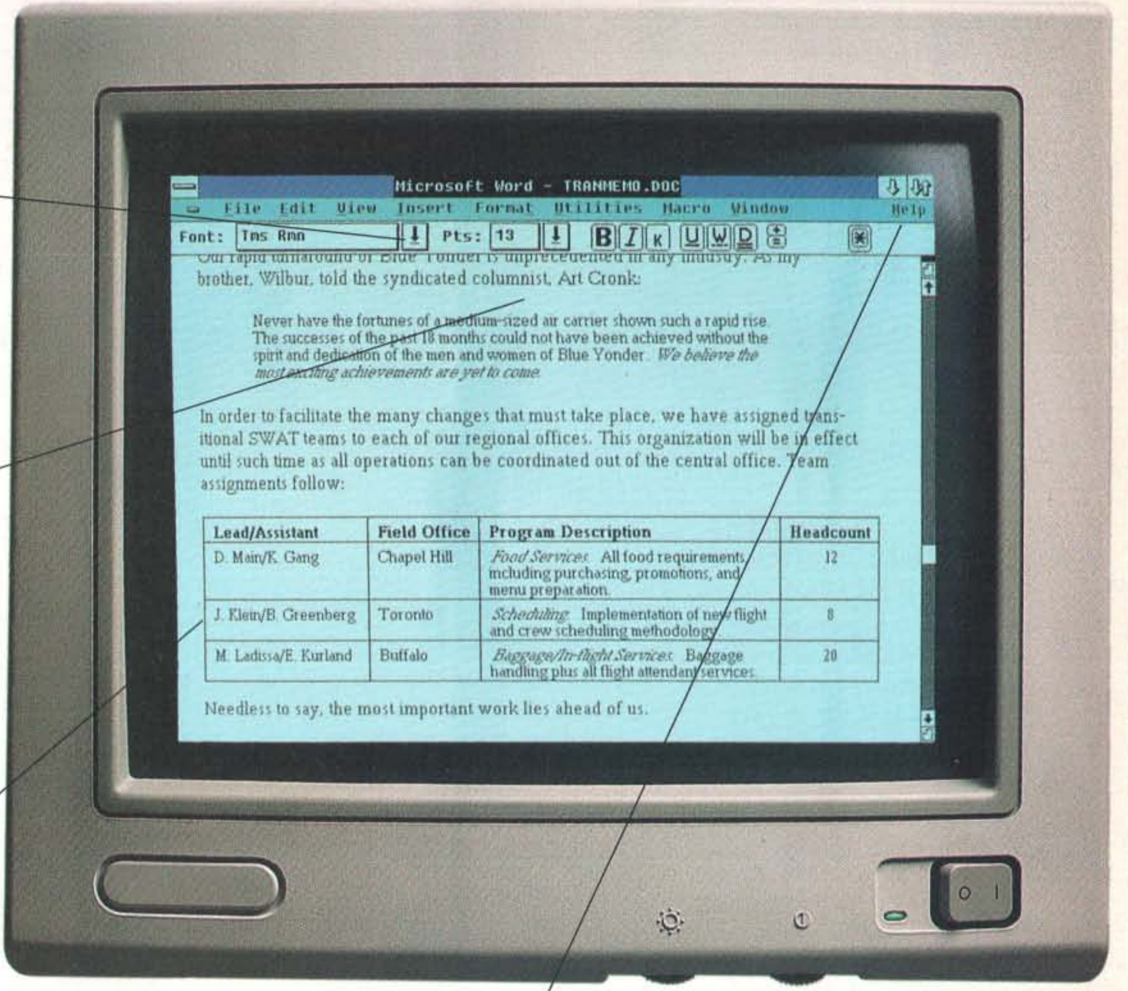
Still only $895, HiWIRE-Plus delivers quality schematics and PCB artwork. You don't need to guess if HiWIRE-Plus is right for you—*we guarantee it!* Try it for 30 days at absolutely no risk. Call toll free today and put HiWIRE-Plus to work for you.

Wintek Corporation
1801 South Street
Lafayette, Indiana 47904-2993
(800) 742-6809 or
(317) 742-8428
FAX: (317) 448-4823
Telex: 15-624-6480

Europe: RIVA Ltd., England,
Phone: 0420 22666, FAX: 0420 23700
Australia: Wintek Software
Phone: (08) 2720028, FAX: (08) 3733145

Circle 400 on Reader Service Card

Introducing the bes
the office memo sinc



They're here...
Intuitive icons on the Ribbon make those everyday tasks, like formatting, as easy as ABC. Or, more precisely, see, point, do.

Save a tree.
WYSIWYG editing shows what each page will look like, before it's printed, a feature that's easy on paper. Not to mention your patience.

We offer outstanding table service.
Now, creating a table is easier than dining out. The Word for Windows table feature allows you to organize numbers, text, and graphics in a spreadsheet-like array of cells. And there's no tab.

Help wanted.
Word for Windows context-sensitive, on-line help gets you up and running quickly. And keeps you there.

Chances are, those simple, everyday memos you've been creating aren't so simple to create anymore. What with the time-consuming process of messing with formatted paragraphs, typefaces, and tables.

And even if your documents aren't formatted, there's probably someone in your office who wishes they were. You, perhaps.

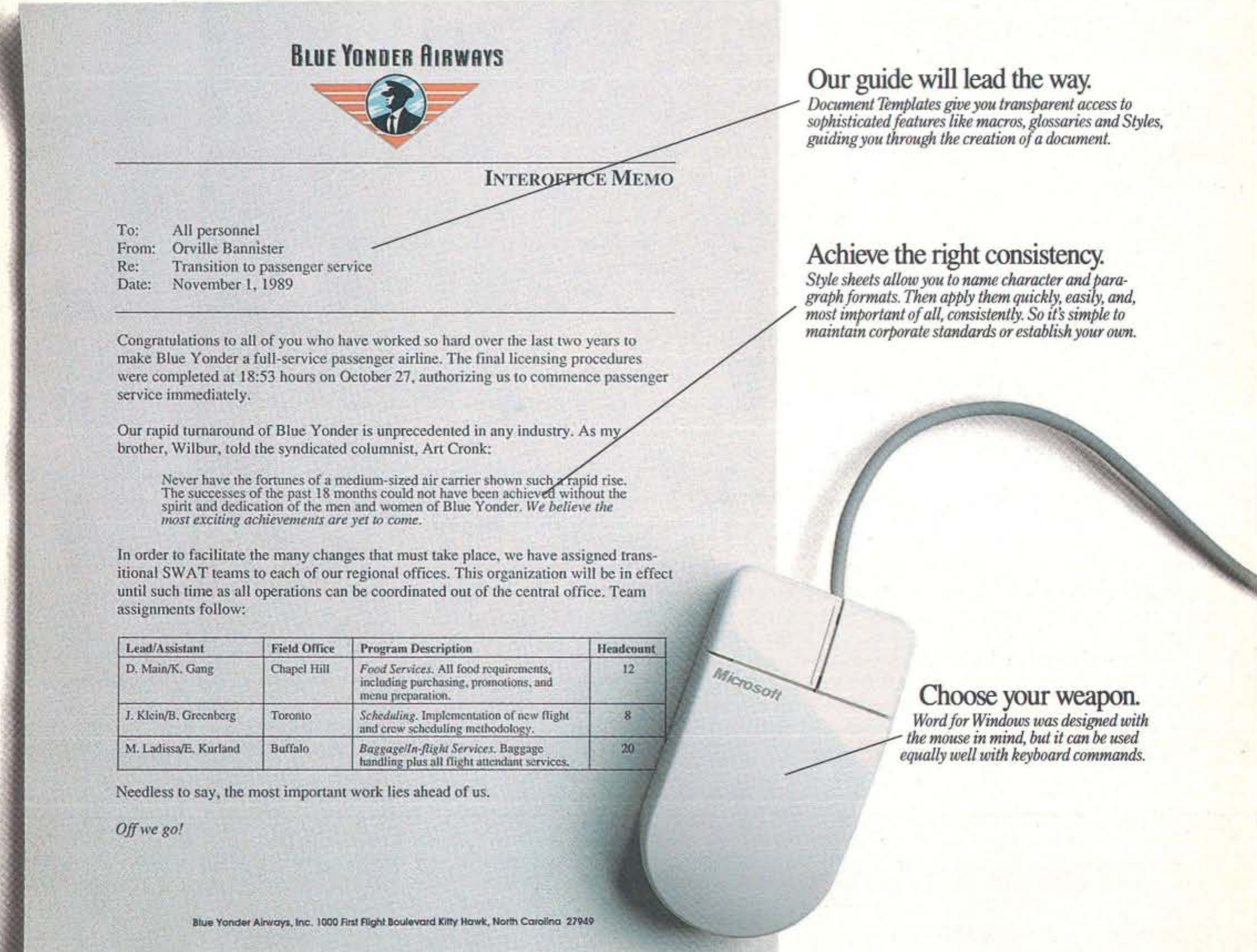
Enter Microsoft® Word for Windows.™ The word processor that compares to predecessors like the correction key compares to white-out.

Word for Windows' intuitive graphical user interface makes the most annoying and mundane parts of everyday memos as easy as ABC.

Or, more precisely, see, point, do.

Its computer-based training program and

t thing to happen to e the correction key.



BLUE YONDER AIRWAYS

INTEROFFICE MEMO

To: All personnel
From: Orville Bannister
Re: Transition to passenger service
Date: November 1, 1989

Congratulations to all of you who have worked so hard over the last two years to make Blue Yonder a full-service passenger airline. The final licensing procedures were completed at 18:53 hours on October 27, authorizing us to commence passenger service immediately.

Our rapid turnaround of Blue Yonder is unprecedented in any industry. As my brother, Wilbur, told the syndicated columnist, Art Cronk:

> Never have the fortunes of a medium-sized air carrier shown such a rapid rise. The successes of the past 18 months could not have been achieved without the spirit and dedication of the men and women of Blue Yonder. *We believe the most exciting achievements are yet to come.*

In order to facilitate the many changes that must take place, we have assigned transitional SWAT teams to each of our regional offices. This organization will be in effect until such time as all operations can be coordinated out of the central office. Team assignments follow:

Lead/Assistant	Field Office	Program Description	Headcount
D. Main/K. Gang	Chapel Hill	*Food Services.* All food requirements, including purchasing, promotions, and menu preparation.	12
J. Klein/B. Greenberg	Toronto	*Scheduling.* Implementation of new flight and crew scheduling methodology.	8
M. Ladissa/E. Kurland	Buffalo	*Baggage/In-flight Services.* Baggage handling plus all flight attendant services.	20

Needless to say, the most important work lies ahead of us.

Off we go!

Blue Yonder Airways, Inc. 1000 First Flight Boulevard Kitty Hawk, North Carolina 27949

Our guide will lead the way.

Document Templates give you transparent access to sophisticated features like macros, glossaries and Styles, guiding you through the creation of a document.

Achieve the right consistency.

Style sheets allow you to name character and paragraph formats. Then apply them quickly, easily, and, most important of all, consistently. So it's simple to maintain corporate standards or establish your own.

Choose your weapon.

Word for Windows was designed with the mouse in mind, but it can be used equally well with keyboard commands.

context-sensitive, on-line help make getting started every bit as natural as using it.

In addition, Word for Windows allows you to make the quantum leap into graphical word processing without losing the equity you have in your current program. It reads and writes files from virtually all word processing applications.

In twenty years of office automation, you've never experienced anything like Word for Windows.

But you can.

Just call (800) 541-1261, and ask the people in Dept. K42 to send you a $9.95* Working Model.

You'll discover that switching to Word for Windows means you won't be making any mistakes.

Microsoft®
Making it all make sense™

narks and Making it all make sense *and Windows are trademarks of Microsoft Corporation. *The Working Model saves and prints documents up to two pages in length; the charge of $9.95 covers shipping/handling, excluding sales tax, and is refundable upon*

MYLEX STRUTS EISA'S STUFF

The most complete EISA offering to date clearly shows EISA's performance edge

As we were going to press, Mike Nadeau, associate managing editor for reviews, and the BYTE Lab got to test the most complete Extended Industry Standard Architecture (EISA)-based product line to date—an i486-based motherboard, a caching SCSI disk drive controller, an Ethernet adapter, and a prototype Texas Instruments Graphics Architecture (TIGA) graphics coprocessor, all from Mylex.

Mike reports that these EISA products are *fast* and that they suggest that we've just scratched the surface of EISA's power. For example, the disk drive controller is by far the fastest SCSI device that we have seen, approaching the performance of the best ESDI caching controllers. The GXE020A TIGA board—incidentally, it is the first 34020-based board that we have tested—scored as much as 45 percent higher on our low-level benchmark tests than any other TIGA board evaluated: This board could well be the year's TIGA performance leader. The other components in the demonstration system are equally impressive.

Motherboard

The prototype MAE 486-25 motherboard looked like a finished product, except for the firmware (an early Phoenix EISA BIOS), which needed some help from device drivers to configure the EISA boards.

It has six 32-bit EISA slots and two 8-bit slots, a 128K-byte write-back external cache, and a socket for a Weitek 4167 math coprocessor. It will accept up to 32 megabytes of RAM in two single-in-line-memory-module memory banks.

The Mylex scored well on the BYTE CPU and FPU benchmarks, with indexes of 6.21 and 27.44, respectively. Mylex has designed this board for use in file servers, Unix/Xenix systems, and engineering and scientific workstations. This explains why the designers added an external RAM cache and the FPU socket when the i486 already has a small cache and an FPU integrated on the chip.

Graphics

The GXE020A TIGA bus-mastering board was in an earlier stage of development. It had preliminary AutoCAD and TIGA drivers, with X Window System, Presentation Manager, and Windows/386 drivers in the works. The company expects to ship the board sometime during the second quarter, which is noteworthy since no one at this time has yet produced even an Industry Standard Architecture (ISA) 34020 board, much less an EISA version.

With 1280- by 1024-pixel resolution (a 1600- by 1280-pixel version is planned), the GXE020A runs at 32 MHz (up to 40 MHz is planned) and supports 256 colors on-screen from a palette of 16 million. Our test unit came with 4 MB of RAM.

Disk Drive Controller

The DCE376 caching SCSI disk drive controller, based on the Intel 80376 processor, was designed for service in networking or multiuser environments. It comes with drivers for MS-DOS 3.3 and 4.0, OS/2 1.1, Novell NetWare 3.0, and 386/ix V.3.2. Our unit came with 1 MB of cache RAM, expandable to 8 MB. The bus-mastering DCE376 supports up to seven SCSI devices, and you can program it for use with optical disks, scanners, tape drives, or CD-ROM drives.

Ethernet

The Mylex LNE390A Ethernet adapter is not a bus-mastering device. Nevertheless, Mylex claims an impressive host-to-adapter data transfer rate of 32 megabytes per second. The adapter is built around a National Semiconductor DP8390 Network Interface Controller, which takes over data buffer and communications management from the system's CPU. It supports both thick and thin Ethernet interfaces, and Mylex provides software support for Novell NetWare 2.15 and 3.0.

Pricing

The downside to all this is the price: The motherboard lists for a steep $7600, including a 128K-byte RAM cache and 4 MB of memory. The TIGA controller goes for $5100—expensive, but only about $500 more than the most expensive 34010-based TIGA boards. The SCSI controller and Ethernet adapters are more reasonable at $1700 (with 1 MB of RAM) and $500, respectively, and the DCE376 is comparably priced with ISA ESDI controllers.

Mylex is perhaps best known for its high-performance motherboards. The company does not sell complete systems to end users, but you can buy the EISA boards for your own system, and at least one vendor, Samsung Electronics, will sell systems using the Mylex motherboard and other EISA products. All the products except the TIGA board should be available by the time you read this.

EISA proponents have bet that bus's future on early availability of EISA-capable products and compatibility with the ISA standard. Mylex has addressed three key areas where bottlenecks occur: disk I/O, graphics, and network communications. The company will be among the first to actually sell EISA boards to end users. So far, EISA is well ahead of Micro Channel at its early stages, and all indications say that this trend will continue. Stay tuned.

—Fred Langa
Editor in Chief
(BIX name "flanga")

BORLAND INTRODUCES TURBO PASCAL 5.5 WITH OBJECTS

Be Objective.

Turbo Pascal,® the world-standard Pascal compiler, adds Object-Oriented Programming with our new version 5.5. We combined the simplicity of Apple's Object Pascal language with the power and efficiency of C++ to create Turbo Pascal 5.5, the object-oriented programming language for the rest of us.

It's easy to extend yourself

If you're already programming with Turbo Pascal, it's easy to extend yourself from structured programming to object-oriented programming. And, Turbo Pascal 5.5 is the *only* compiler that is 100% source-code compatible with your existing Turbo Pascal 4.0 and 5.0 programs.

A fast object lesson

Object-oriented application programs more closely model the way you think. Objects contain both data and code. As in a spreadsheet cell, the value and the formula are together. Objects can *inherit* properties from other objects. For example, a Porsche Carrera inherits most attributes from the base model 911, but it also sports a whale tail.

Turbo Pascal 5.5's object-oriented extensions give you code that's easier to change, extend, and support.

Inheritance provides powerful modeling capabilities by allowing objects to inherit attributes from other objects.

Turbo Pascal 5.5 Professional with Turbo Debugger® and Turbo Assembler®

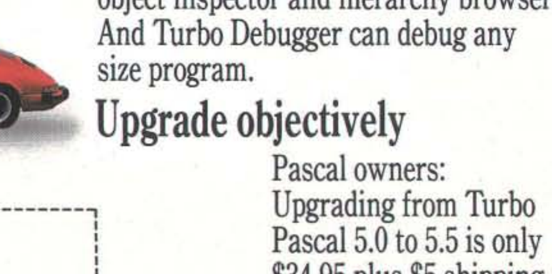
The award-winning Turbo Debugger now includes an object inspector and hierarchy browser. And Turbo Debugger can debug any size program.

Upgrade objectively

Pascal owners: Upgrading from Turbo Pascal 5.0 to 5.5 is only \$34.95 plus \$5 shipping and handling (\$75 plus shipping and handling for owners of Turbo Pascal 4.0 or earlier). And upgrading from Turbo Pascal 5.0 and earlier to Turbo Pascal 5.5 Professional is only \$99.95 plus \$10 shipping and handling. To order, CALL (800) 331-0877.

Turbo Pascal 5.5 Features

- Inheritance
- Static & dynamic objects
- Constructors & Destructors
- Object constants
- Compiles @ > 34,000 lines/minute
- New integrated environment tutorial
- Hypertext Help with copy and paste
- Enhanced smart linker & overlay manager
- Support for 8087/80287/80387
- Integrated source-level debugging



BORLAND

Code: MA54

Mail upgrade orders to: Borland, P.O. Box 660001, Scotts Valley, CA 95066-0001. For orders outside the U.S., call (408) 438-5300.

Circle 49 on Reader Service Card (DEALERS: 50)

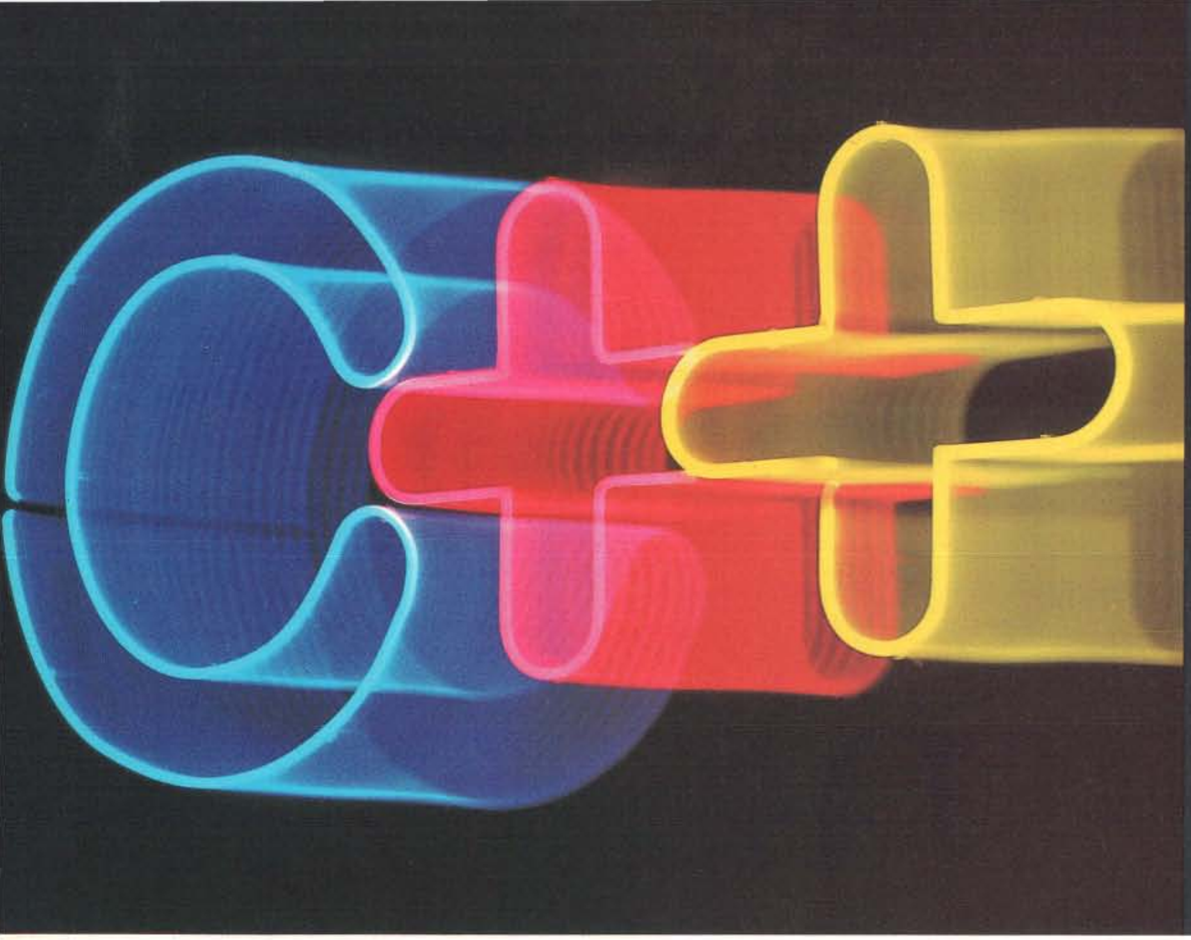
BYTE

See listing on page 345.

BIX BYTE INFORMATION EXCHANGE

EDITORIAL AND BUSINESS OFFICE:
One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.
West Coast Branch Offices: 425 Battery St., San Francisco, CA 94111, (415) 954-9718; 3001 Red Hill Ave., Building #1, Suite 222, Costa Mesa, CA 92626, (714) 557-6292.
New York Branch Editorial Office: 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3175.
BYTEnet: (617) 861-9764 (set modem at 8-1-N or 7-1-E; 300 or 1200 baud).
Editorial Fax: (603) 924-2550. **Advertising Fax:** (603) 924-7507.
SUBSCRIPTION CUSTOMER SERVICE: Outside U.S. (609) 426-7070; inside U.S. (800) 232-BYTE. For a new subscription—(800) 257-9402 U.S. only, or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520. Subscriptions are $29.95 for one year, $54.95 for two years, and $74.95 for three years in the U.S. and its possessions. In Canada and Mexico, $31.95 for one year, $59.95 for two years, $79.95 for three years. $50 for one-year air delivery to Europe. Y28,800 for one-year air delivery to Japan, Y14,400 for one-year surface delivery to Japan, $30 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $3.50 in the U.S. and its possessions, $3.95 in Canada, $4.50 in Europe, and $5 elsewhere. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue.

EDITORIAL CORRESPONDENCE:
Address editorial correspondence to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Unacceptable manuscripts will be returned if accompanied by sufficient postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.



The Gordian Knot. A legendary case of complexity. It had baffled and stymied the best minds of the ancient world until Alexander the Great cut through the convoluted challenge with one bold, swift stroke of his sword. This "seat-of-the-pants" solution set in motion the prophecy that whoever unraveled the knot would one day rule Asia.

"THIS IS THE RIGHT WAY TO DEVELOP APPLICATIONS FOR OS/2 PM.
OS/2 PM is a tremendously rich environment, which makes it inherently complex. Smalltalk/V PM removes that complexity, and lets you concentrate on writing great programs. Smalltalk/V PM is the kind of powerful tool that will make OS/2 the successor to MS/DOS."

Bill Gates, Chairman
Microsoft Corp.

fast, seat-of-the-pants way

THE FIRST FULLY-COMPILED SMALLTALK.
Because Smalltalk/V PM is fully compiled it provides you with a more responsive environment than ever before. Now you'll be able to generate stand-alone applications (.EXE).

ately start creating without any limitations on your efficiency.

However, if you're the curious type, we have tools called browsers to help you fathom the masterpiece called OS/2 PM. You'll also find our incremental program development capability and push-button debugger simplifies application development and gives you instant response when you implement an idea. Our extensive user manuals and tutorials have earned us high praise.

SMALLTALK/V PM. THE TALKING HAS ALREADY STARTED.

"Digitalk's Smalltalk/V PM is a masterful implementation of a classical object-oriented programming language and a state of the art graphical user interface. Any programmer struggling with the complexities of Presentation Manager should take a close look at this product."

Charles Petzold, Contributing Editor, PC Magazine

"Digitalk's Smalltalk/V PM is dazzling! This product makes Presentation Manager pay off."

Jeff Duntemann, Contributing Editor, Dr. Dobbs Journal

"Smalltalk/V PM is an excellent tool for rapid delivery of prototypes which have all the functionality and user interface of a complete PM application."

Richard A. Landsman, System Architect, Lotus Development

"Smalltalk/V PM from Digitalk is the greatest! This is an incredible product."

J.D. Hildebrand
Editor-in-Chief, Computer Language

THE BEST PM INVESTMENT YOU'LL EVER MAKE
Smalltalk/V PM $499.95
Prices and information on these and other Digitalk products are available on request:
Smalltalk/V, Smalltalk/V 286, Smalltalk/V Mac

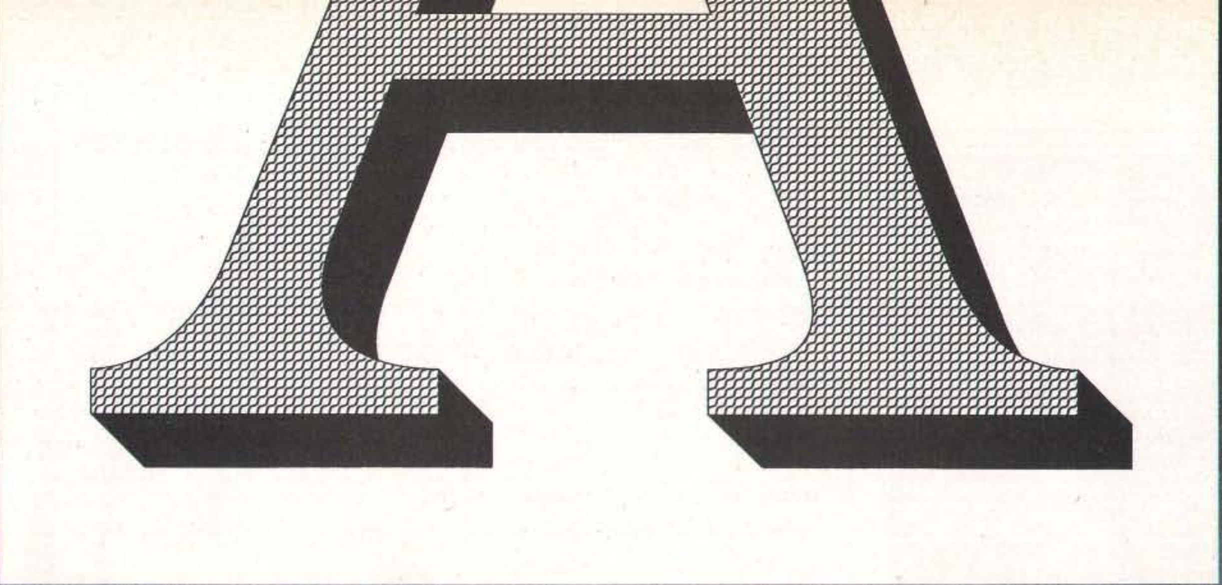
Smalltalk/V. A product of Digitalk Inc., 9841 Airport Blvd., Los Angeles, CA 90045. For information or to find a dealer near you call:

1-800-922-8255
1-213-645-1082

CompuServe 71361,1636
FAX 1-213-645-1306

Smalltalk/V

Circle 91 on Reader Service Card



Scalable Fonts
What they are and how to get them free.

For hundreds of years, metal font typefaces were stored by printers in typecases—to be set by hand on printing presses. This system was modernized by machines that set type in paragraphs at a time—which created a revolution for the publishing industry.

The nine scalable fonts built into Canon® Laser Beam Printers represent the same kind of advance for PC users. Scalable fonts are actually mathematical formulas that allow you to create the exact size font you want—from fine print to type too large to fit on a single page.

What's more, they can be rotated, and filled with patterns or shadows for effect. Gone are the days of juggling font cartridges, or filling up scarce disk space with soft fonts.

And now through June 30, 1990, Canon® Laser Beam Printers are an even *better* buy. You'll receive a free SC-1™ IC card with 22 more scalable fonts (seven typefaces): A $195 value, *free.*

Call 1-(800)-767-4300 to receive our free brochure with instructions on how to take advantage of this free offer—and start improving your image right now.

Circle 56 on Reader Service Card

A printer driver kit is provided free with each printer containing all printer definition files currently available on diskette, plus complete installation instructions.

Canon®

LASER BEAM PRINTERS

Working to improve your image.™

MICROBYTES

Staff-written highlights of developments in technology and the microcomputer industry, compiled from Microbytes Daily and BYTEWEEK reports.
Edited by D. Barker

Optical Computer No Longer Light Years Away

Researchers at AT&T Bell Labs have successfully demonstrated what they call the world's first digital optical processor, an experimental device that performs calculations using optical switches and beams of light instead of transistors and electricity. The processor holds the promise of future computers that are much faster than current machines and more adept at handling multiple tasks simultaneously.

The tabletop processor bears little resemblance to a silicon chip; in fact, it looks like a Rube Goldberg contraption. Measuring about 2 feet on a side, the processor is made up of lenses, mirrors, prisms, light-sensitive chips, and laser diodes stripped from commercial compact disk players (the scientists hope to someday fit all this into 3 square inches). Four video cameras read the "output" and display a matrix of dots on large TV screens.

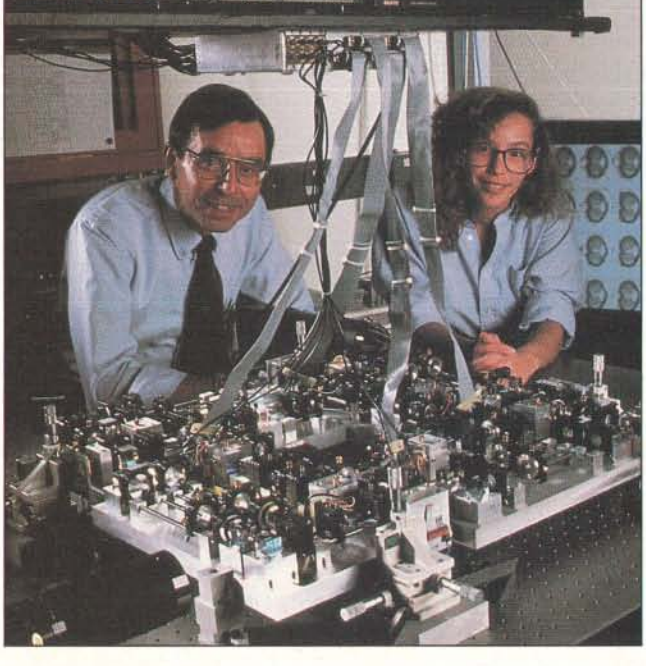
At the heart of the processor are tiny optical switches, called S-SEEDs (Symmetric Self-Electro-Optic Effect Devices). Each S-SEED contains two mirrors whose reflectivity to infrared light can be controlled by a separate optical input. The processor contains four arrays of 32 S-SEEDs, and each S-SEED acts as a NOR logic gate. Bell Labs estimates that the area occupied by one conventional electrical path could hold 256 optical gates.

The processor calculates by sending light beams from the laser diodes through a series of lenses and masks to the S-SEEDs, which either reflect or absorb the light, depending on logic. Each array then cascades its output to the next array as input. In this way, the processor is able to count, at an execution speed of about 1 million cycles per second. Since S-SEEDs can switch at up to 1 billion cycles per second, the processor might someday be able to run hundreds of times faster than it does now. Among the impediments to building a speedier version: Researchers can't debug it with conventional computers because they're too slow.

While the optical processor is far from a functional computer, the Bell Labs researchers, led by Alan Huang, hope to challenge skeptics who question whether a completely optical

continued

They do it with mirrors. And prisms, lenses, light-sensitive chips, and laser diodes. Bell Labs staff member Maralene Downs and consultant Nicholas Craft with the digital optical processor they helped build. Although the researchers caution that an optical computer is several years away, their experimental device is a major step toward computing at the speed of light.



NANOBYTES

Despite the prospect of tremendous growth for computer companies in **Europe, the main trend will be downsizing**, predicts Vittorio Cassoni, group managing director of Olivetti in Italy and a former AT&T executive. Cassoni said at the recent Personal Computer Forum that all European companies involved in information technology are currently overstaffed and will have to cut back. Some companies that have not reached "critical mass" will not survive, he said. As for the growth potential in Europe, Cassoni stated that Europe is much less penetrated by computer technology than the U.S., so there's more opportunity for selling OS/2, 386-based systems, and other leading-edge technology.

The **Open Software Foundation** (Cambridge, MA) has shipped its first "snapshot," or preliminary source code, of the **OSF/1** operating system to member companies. This version contains elements from Mach, BSD, AIX, and Encore implementations of Unix. Future snapshots will be released on a bimonthly basis, and availability of the final snapshot is slated for November, the company says. One Unix observer pointed out at UniForum, where OSF made its announcement, that it took eight passes through the snapshot process before OSF's Motif user interface was stable.

Meanwhile, AT&T's **Unix System V release 4.0**, Goliath to OSF/1's David, was all over the UniForum show floor. But when will the operating system be commercially released? Good question. A senior staffer for the Unix Software Operation said that **Intel** is in the best position to bring it to market first. Intel says July is most likely. AT&T is allowed to ship only source code, so it's up to other companies to get the new Unix compiled and running.

computer can ever be built. Some computer scientists maintain that optics will be restricted to system I/O and connections between electronic components. And some say that optical gates will never be a practical alternative to transistors.

A fully optical computer is more than five years away, according to the Bell Labs group. The most viable use now for optical technology is in hybrid systems that combine optics and electronics. The researchers are now focusing their work on optical interconnects between chips, which could be practical in as little as three years. Optical interconnections could vastly increase the amount of data moving in and out of chips.

A big problem with electronic chips is their data I/O bottleneck: Signal lines need a critical mass to carry data and must be kept far enough apart to prevent cross talk. By contrast, light is very resistant to interference and has a huge bandwidth. Streams of photons can even cross one another without causing any distortion.

Optics and computers will likely converge gradually. The Bell Labs processor is a significant step toward an optical computer, but there are other hurdles, including developing techniques for programming an optical machine. By 1995, AT&T says, supercomputers and telecommunications computers could contain 20 percent to 30 percent optical components; by the year 2000, as many as half the components could be optical. But it will be quite a while before you'll be running your favorite application program on your desktop optical computer.

—Andy Reinhardt

Have They Been Doing It Wrong? Discovery Could Help Chip Makers, Researcher Says

In the process of designing a device for monitoring peak voltages on silicon surfaces, a Stanford University researcher says that he accidentally made a discovery that could greatly improve manufacturing yields and the reliability of ICs. Contrary to a basic assumption governing silicon chip design and production, Dr. Wieslaw Lukaszek says that he discovered that the process of depositing electrical charge on silicon surfaces (called *doping*, it's used to introduce voltage differentials into a semiconductor) tends to distribute the charge evenly over the surface, rather than concentrating the charge in proportion to the area of the surface.

Until this discovery, Lukaszek says, chip manufacturers have assumed that ion implanters and other charging devices act as a current source and deposit their charge on the silicon wafer in proportion to the size of its area. On the basis of this assumption, manufacturers have believed that they could prevent excessive electrical charge simply by limiting the size of the polysilicon wafer.

With this same assumption in mind, Lukaszek set out to design a peak voltage monitor that could measure and store in memory the voltage levels of a wide range of silicon structures subjected to electrical charge. Lukaszek says he found that "no matter what the size of the polysilicon structure, it sees the same voltage [given the same electrical charge]." In other words, explains Lukaszek, "the ion implanter behaves more like a voltage source than a current source." Or, in still other words, a basic assumption of making semiconductors is wrong, he claims. Until now, there has been no way of verifying the assumption, Lukaszek says. "It was based on looking at the residual damage in chips, sort of like doing an autopsy."

Lukaszek hopes to work with semiconductor companies to refine his voltage monitor so that the manufacturers can gain a better understanding of what's going on. Lukaszek told Microbytes Daily that he thinks this new insight could lead to better control of manufacturing conditions and less electrical "stress" on silicon wafers, thus resulting in higher yields. His finding could possibly enable manufacturers to understand better how silicon wafers behave in response to doping and then to redesign their equipment without worrying about wafer area, but focusing instead on other factors. "Manufacturers have been getting clobbered, and they didn't know about it," he says.

—Nick Baran

continued

NANOBYTES

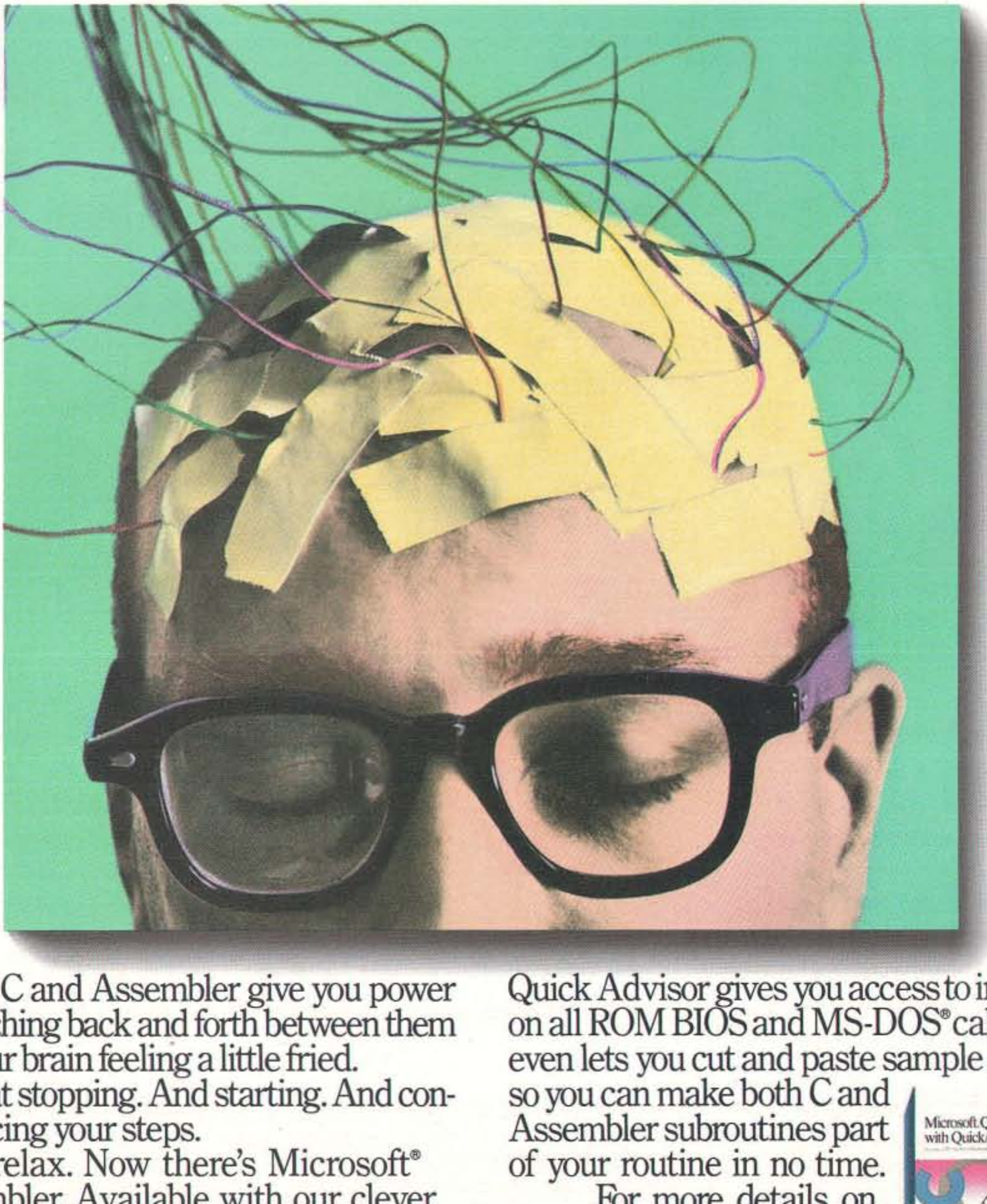
Open Look, AT&T and Sun's answer to the OSF/Motif graphical user environment, has been upgraded. An AT&T representative said that Open Look 2.0 includes bug fixes and performance enhancements, as well as utilities that used to be options.

Intel (Santa Clara, CA) has formed a joint venture with the Japanese company **NMB Semiconductor** to manufacture and market high-speed DRAM chips. The new Intel/NMBS DRAM Fabrication Co. plans to make 1- and 4-megabit chips at NMB's site in Tateyama City, Japan, and eventually in the U.S. NMBS will handle the manufacturing, and Intel, the marketing.

Prometa USA (Gainesville, FL) showed at UniForum a Motorola **88000-based coprocessor** card that plugs into **Micro Channel-based computers**. Using bus-mastering techniques, the board handles its own I/O, freeing the host processor to run DOS or OS/2 applications without additional overhead. The board runs Unix System V release 3.2. Prometa has built extensions to Microsoft Windows and Presentation Manager to allow execution of Unix programs from within DOS and OS/2. Prometa subscribes to the 88open Binary Compatibility Standard, so applications built for other 88000 platforms should run unmodified on Prometa's card.

Graphic Software Systems (Beaverton, OR) now has a version of its XVT (Extensible Virtual Toolkit) graphical interface library that runs under **OSF/Motif**. Previously, XVT allowed programmers to create interface modules in C that can be compiled with minimal changes across Microsoft Windows, Presentation Manager, Macintosh, and nongraphic character displays. GSS has enhanced XVT with color support, dynamic menu modification, text editing, and child windows. A Universal Resource Language specification and compiler allow interface elements to be textually described and transported across various platforms, GSS says.

Until now there was only one way to integrate C and Assembler.



While C and Assembler give you power to burn, switching back and forth between them can leave your brain feeling a little fried.

All that stopping. And starting. And constantly retracing your steps.

Well, relax. Now there's Microsoft® QuickAssembler. Available with our clever QuickC® Compiler in one location: the first integrated environment for C and Assembler.

For the first time, you can save time with an integrated editor, compiler, assembler and debugger that let you create C programs, mixed C and Assembler programs, or Assembler programs that stand alone.

To make sure you feel at home in your new environment, we've designed Microsoft Quick Advisor, a hypertext electronic manual that coaches, coaxes and guides you on screen.

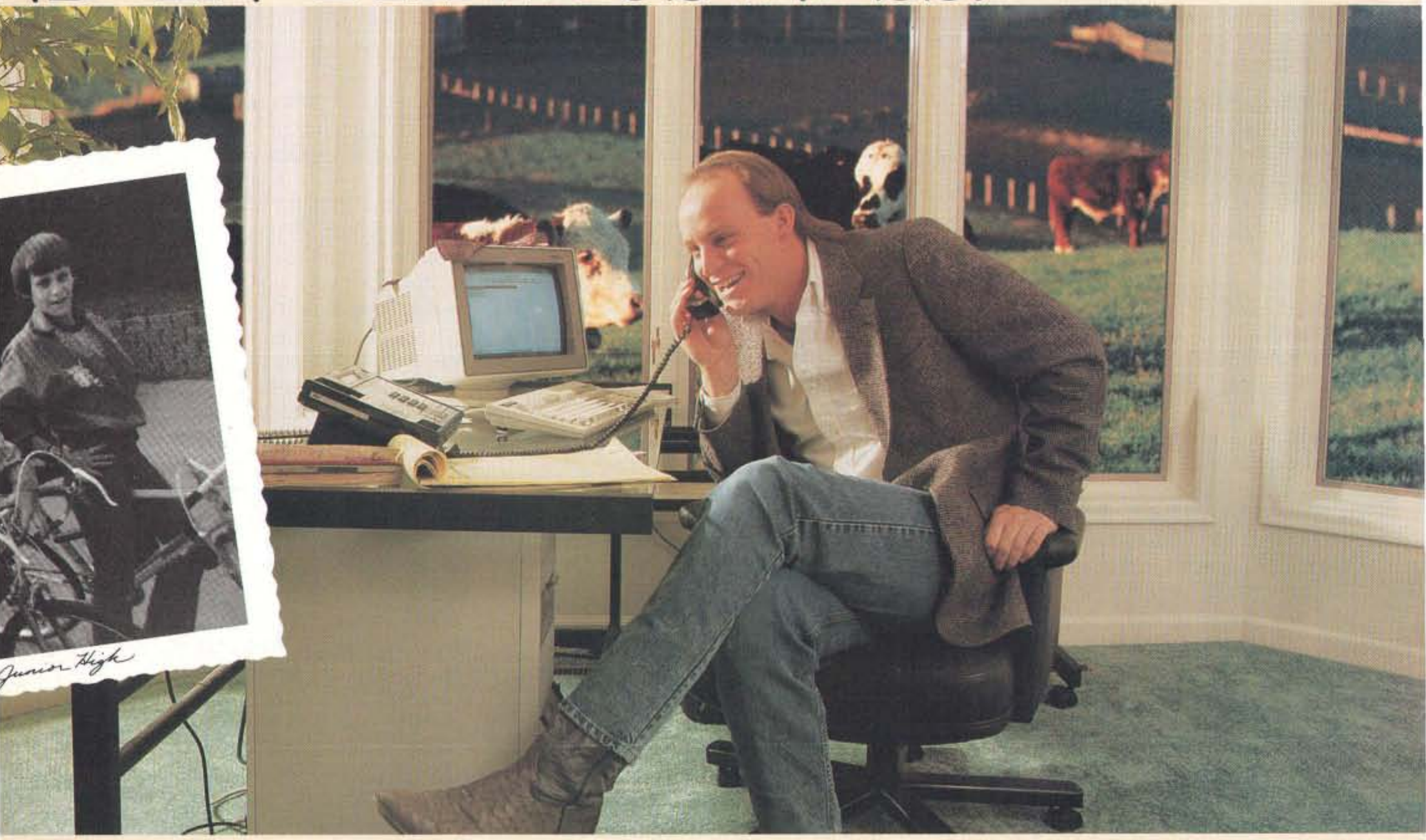
Quick Advisor gives you access to information on all ROM BIOS and MS-DOS® calls. And it even lets you cut and paste sample programs, so you can make both C and Assembler subroutines part of your routine in no time.

For more details on the incredible integrated power of QuickAssembler and QuickC Compiler, call (800) 426-9400. If you own QuickC Compiler version 2.0 already, we'll tell you how to add on QuickAssembler quick.

And take a load off your mind.

Microsoft®
Making it all make sense.™

ND IN THE BUSINESS.



12 MHZ ▪ 286 VGA

- 80286-12 Processor
- 2 Megs RAM
- 1.2 Meg 5¼″ Drive
- 1.44 Meg 3.5″ Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14″ 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$1995.00

GATEWAY ▪ 386SX

- 2 Megs RAM
- 1.2 Meg 5¼″ Drive
- 1.44 Meg 3.5″ Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14″ 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2195.00

20 MHZ ▪ 386 VGA

- 4 Megs RAM
- 1.2 Meg 5¼″ Drive
- 1.44 Meg 3.5″ Drive
- 65 Meg 28ms RLL Drive
- 16 Bit VGA with 512K
- 14″ 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$2695.00
64K Cache Add $500

25 MHZ ▪ 386 VGA

- 4 Megs RAM
- 1.2 Meg 5¼″ Drive
- 1.44 Meg 3.5″ Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14″ 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$3395.00
64K Cache Add $500

Due to the volatility of the DRAM market all prices are subject to change.

33 MHZ ▪ 386 VGA

- 64K Cache RAM
- 4 Megs RAM
- 1.2 Meg 5¼″ Drive
- 1.44 Meg 3.5″ Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14″ 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

$4395.00

25 MHZ ▪ 486 VGA

- 4 Megs RAM
- 1.2 Meg 5¼″ Drive
- 1.44 Meg 3.5″ Drive
- 160 Meg ESDI Drive
- 32K Cache Controller
- 16 Bit VGA with 512K
- 14″ 1024 x 768 Color Monitor
- 1 Parallel & 2 Serial Ports
- 101 Key Keyboard
- MS DOS 3.3 or 4.01

Call For Price

This device has not been approved by the Federal Communications Commission. This device is not, and may not be offered for sale or lease, or sold or leased until the approval of the FCC has been obtained.

NANOBYTES

Omron Advanced Systems (Cupertino, CA) is looking for remarketers in the U.S. to sell its Luna workstations. Manufactured in Japan, the Luna systems incorporate advanced performance and features in a small package. The original Luna, based on a 68030/68882 CPU/math coprocessor combination, includes 8 megabytes of RAM, a 150-MB hard disk drive, a 155-MB tape backup system, and a 19-inch monochrome display. The Luna runs Mach 2.5 (the operating system on which OSF/1 is based). Retail pricing is not set, but the product is less than $7000 in OEM quantities. The Luna/88K, a multiprocessing workstation, will incorporate up to four coupled Motorola 88000 chip sets running at 33 MHz.

Frame Technology Corp. (San Jose, CA) has signed with The Santa Cruz Operation (Santa Cruz, CA) to port **FrameMaker** desktop publishing software to **SCO's Open Desktop** graphical environment.

In a move prompted by **Compaq's** debut last November of its SystemPro, **Zenith** plans to offer an **enhanced version of its Z-1000 multiprocessing Unix system** in May. The Z-1000 currently uses two to six 386 processors; they're linked using a special bus configuration that includes standard AT-bus-style connectors and "C-Bus" connectors developed by Corollary. The new version of the Z-1000 will have EISA connectors in place of the AT connectors and will be able to use i486 processors as well as 386s. Zenith says that with six i486s in place, the new system will be capable of over 100 MIPS. Since the Z-1000 uses a passive backplane type of bus, current owners should be able to upgrade to the EISA version easily. As for software, the current Z-1000 can run only a special multiprocessing version of Unix. Zenith said that in the future, it will offer a multiprocessing version of Microsoft's LAN Manager and Novell's NetWare. Compaq has promised a multiprocessing version of LAN Manager (with two processors) for its SystemPro.

IBM Will Offer NeXT Environment to Unix Users

It came as no surprise, but it's good news for NeXT. IBM announced officially that it will offer NeXT's NextStep user interface and development environment on its workstations and PS/2 personal computers running AIX, IBM's version of Unix. IBM licensed NextStep from NeXT in 1988 but then made no public commitment to using it. While it's not yet clear that users of IBM's new RT will want to run NextStep on top of AIX 3, the fact that it's an option gives NeXT's environment the official seal of approval from the world's biggest computer company.

NextStep is a graphical user interface layer for Unix. NeXT uses a version of Unix called Mach, developed primarily at Carnegie Mellon University. IBM's AIX version of Unix is not compatible at the binary level with Mach; therefore, programs developed on NeXT Computers will have to be recompiled to run under AIX, and IBM programs developed with NextStep will have to be recompiled to run on NeXT Computers. While it is likely that little, if any, code modification will be necessary because NextStep uses a consistent graphics model on either NeXT or IBM systems, neither company has publicly demonstrated the portability of NextStep applications.

IBM will also support the Open Software Foundation's Motif interface, which can be considered a competitor of NextStep. NextStep has advantages over OSF in that it offers an excellent development environment for programmers with its Interface Builder and Application Kits, which facilitate software design. NextStep's possible disadvantage is its use of a proprietary windowing system, while most of the Unix market has settled on the the X Window System. While the Window Server doesn't have the acceptance that the X Window System has gained, some NeXT users have said that they think it's superior.

Some major software companies have already said that they're developing applications to run under NextStep, including Lotus, Informix, WordPerfect, and Adobe.

IBM's decision to offer NextStep is good news for developers working on NextStep applications. It gives them the opportunity to market their programs on IBM PS/2s and workstations that run AIX.

—Nick Baran

Group Proposes Decorum for OSF

In an effort to set an industry standard for distributed computer networks that contain software and hardware from different vendors, the Open Software Foundation (Cambridge, MA) has been evaluating responses to its "request for technology." Although the OSF has received 50 proposals for a standard distributed computing environment, observers say that one of the front-runners is Decorum, backed by a group that includes IBM, Microsoft, DEC, Apollo, Locus Computing, and Transarc.

Decorum defines tools that developers can use to more easily create applications for distributed environments. Although obviously aimed primarily at Unix-based environments, the proposal also defines ways of connecting with other operating systems, including DOS and OS/2. Other main components include remote procedure calls using Apollo's Network Computing System protocols; process transparency, provided by the Transparent Computing Facility, jointly developed by IBM and Locus; and a distributed file system, based on Transarc's AFS (formerly the Andrew File System of Carnegie Mellon). These provide support for uniform file systems across networks, as well as for integrating DOS and Unix file systems.

Rounding out the complex proposal are threading facilities based on POSIX, time services using the Network Time Protocol (NTP), distributed access to remote devices, administrative services for managing and monitoring networks, and capabilities for diskless systems.

A spokesperson for the Decorum group says that each of the major components of the proposal are designed as independent layers that can be combined into a complete distributed computing environment.

continued

New FoxPro

Classic Beauty. Legendary Power.
A Higher Standard in Relational Databases.

Introducing FoxPro. The *only* relational database management system that combines astonishing performance with a sleek interface of amazing power and beauty.

- FoxPro offers all the elegance and accessibility of a graphic-style interface, yet operates at the stunning speeds possible only with character interfaces.
- FoxPro is so easy to learn and use, even beginners can become productive immediately; yet it's powerful and sophisticated enough to satisfy the needs of the most demanding developers and power-users.
- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it's able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don't even need a graphics card or special windowing software.

Nothing is Faster

Fox Software products are famous for their unmatched execution speed. FoxPro extends that tradition.

FoxPro is up to eight times faster than dBASE IV—more than 15 times faster than dBASE III PLUS!

And that blazing speed translates into unprecedented power. Now you can efficiently process gigantic databases with hundreds of thousands—even *millions*—of records.

Protecting Your Investment

With FoxPro, your existing FoxBASE+ or dBASE III PLUS programs will run perfectly—first time, every time, no excuses. And FoxPro is language-compatible with dBASE IV.

But FoxPro doesn't stop there. It has over 140 language enhancements not found in any version of dBASE. We've outdone ourselves by adding more than 200 language extensions you won't find in FoxBASE+.

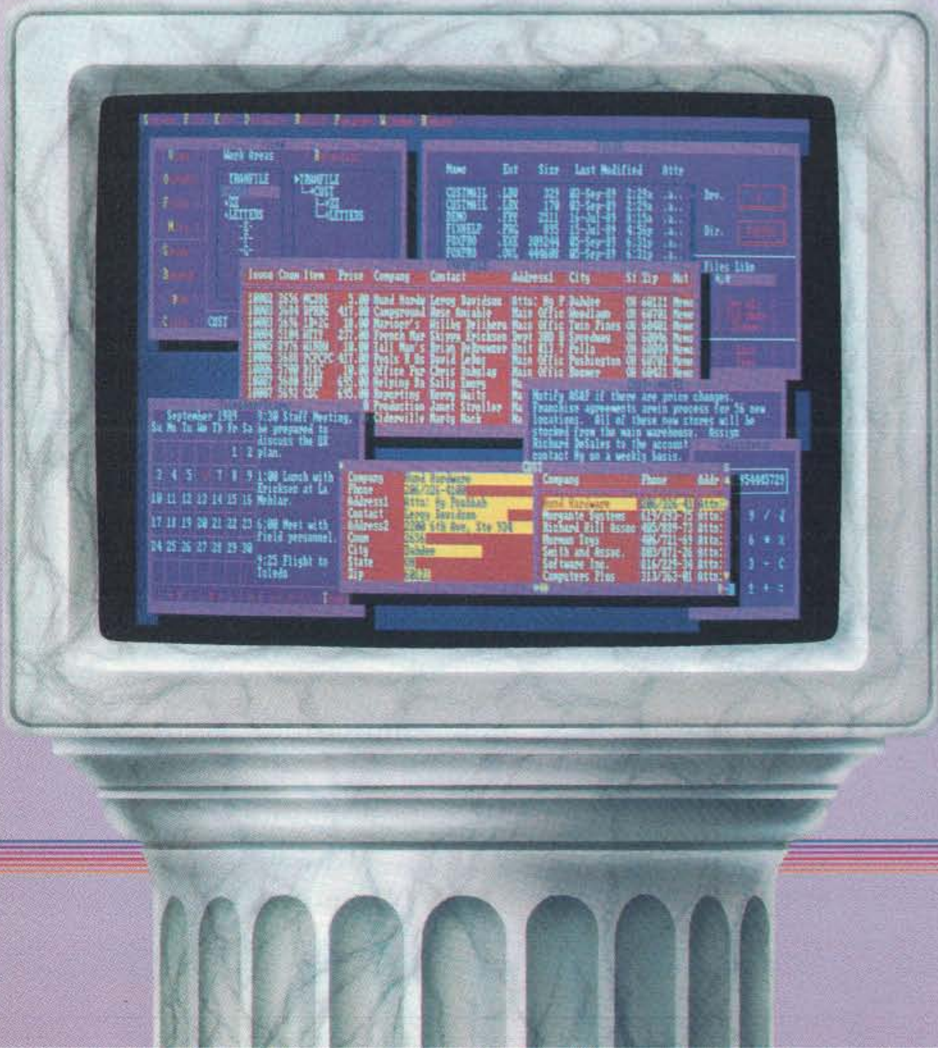
Best of all, FoxPro opens up whole new worlds for your applications by letting you move them onto a variety of different platforms.

The Tradition Continues

Fox Software is committed to excellence—our products prove it.

We've been producing superb database management software since 1983. And our products for both the PC and the Macintosh continue to win awards worldwide.

We've taken everything we know about software engineering, databases and interface design, and focused it into one remarkable product—FoxPro.



FREE Demo Disk

But don't just take our word for it. Try FoxPro for yourself, and see what the higher standard of database management can do for you.

Call (419) 874-0162 now to get your free demo disk. Or ask for the FoxPro dealer nearest you. One look, and we think you'll agree: *Nothing Runs Like The Fox.*

FoxBASE+ Users: Call About Our Liberal Upgrade Offer!

System Requirements: *FoxPro operates in 512K RAM (640K recommended) with MS/PC-DOS 2.0 or greater and an 8086/8088, 80286 or 80386 microprocessor. For optimum performance, FoxPro takes complete advantage of any available EMS (expanded memory) or a math coprocessor.*

Trademark/Owner: FoxPro, FoxBASE+/Fox Software; dBASE III PLUS, dBASE IV/Ashton-Tate.

Fox Software

Nothing Runs Like The Fox.

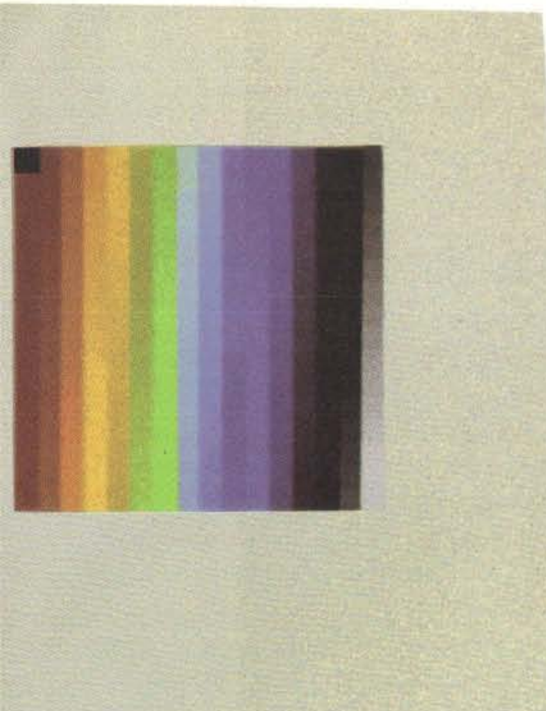
Fox Software, Inc.
134 W. South Boundary
Perrysburg, Ohio 43551

(419) 874-0162
FAX: (419) 874-8678
Telex: 6503040827 FOX

Circle 121 on Reader Service Card

Most VGA monitors this colorful,

Image created on the Samsung VGA-GraphicMaster™ color monitor using RIX Softworks, Inc. Software. Unretouched photograph. © 1989, Samsung Information Systems America, Inc.



NANOBYTES

The **Soviet software industry** isn't much of an industry just yet, according to **Alexey Pajitnov**, developer of the popular **Tetris** computer game and probably the USSR's most famous programmer. "We have practically no software products, only programs. We have a very small number of computers, and usually we use them only for scientific or research applications," he said during a recent tour of the U.S. to promote his new game, Welltris (distributed by Spectrum Holobyte). Soviet programmers work "in the same style" as Western ones, Pajitnov said. As for computers in the Soviet Union, Pajitnov doesn't expect to see a PC on every desktop in the near future. He said that his country has "a lot of serious problems" like food shortages and civil unrest that need greater attention.

Meanwhile, **ComputerLand** is opening the first computer store in the Soviet Union. The new **Moscow franchise** will sell systems from IBM, Compaq, AST, Epson, and Hewlett-Packard. The store will not sell Macintoshes yet because Apple is currently developing a Cyrillic keyboard for the Russian market, according to ComputerLand spokesperson Brian Okun. The Moscow store will be owned by Michael Tseytin, a Russian immigrant who owns ComputerLand franchises in Secaucus, New Jersey, and Dresher, Pennsylvania.

Are you lonesome tonight? **UUNET Communications** (Falls Church, VA), an independent company directly connecting 130 Unix sites around the world, has started a telephone-based service through a 900 number. At a rate of 40 cents per minute (telephone toll charges included), users of the 900 number can send E-mail to any machine in the worldwide network of some 100,000 computers and can also pull public files off the UUNET machine, which is the repository for most **free Unix software**, including the source code for the X Window System from MIT and GNU compilers and editors.

Each layer is designed to operate with the others, yet remain independent.

Another prominent proposal comes from Sun Microsystems and involves Sun's Network File System, which is a standard of sorts in the Unix world and is more mature than most of the components in the Decorum model. Even though Sun is an industry rival of the OSF, the group has shown a remarkable ability to cut through politics and meld technologies from competing companies. A decision on the distributed computing environment could come this month.

—Stan Miastkowski

Ethernet-on-a-Chip Will Save PCs a Slot

Turning an IBM PC or compatible into an "Ethernet-ready" system usually involves plugging a network card into a valuable expansion slot. But now U.S. Sage (Longwood, FL) has developed a chip that incorporates most Ethernet hardware functions. The company hopes that PC makers will use the Ethernet Needing Zero Overhead (ENZO) chip on their motherboards.

ENZO combines most of the Ethernet hardware functions on a single chip, according to U.S. Sage president Alex DuBrow. The LAN controller and Manchester encoding/decoding functions, which often require two chips on Ethernet boards, are included in the chip. ENZO is compatible with the IEEE 802.3 Ethernet network standard and supports both Novell's NetWare and U.S. Sage's MiniLan operating systems, the company says.

Building an Ethernet-ready motherboard really isn't a new concept (witness the NeXT Computer). But it's an idea that hasn't been exploited by manufacturers of IBM compatibles. DuBrow thinks that PC makers (and, in turn, users) can benefit from the LAN-on-a-chip technology; ENZO sells for only $10 to $25 (in OEM quantities), and it frees up a slot. DuBrow claims that U.S. Sage has received "strong inquiries" about ENZO and has sent out about a dozen evaluation kits, some to PC manufacturers.

—Jeffrey Bertolucci

Mike Will Replace Mouse, Apple Exec Says

The "ask and tell" interface will eventually replace the mouse and keyboard for many applications, and the microphone will play an important role in this new interface, says Apple Computer vice president of advanced technology Lawrence Tesler.

Newer, more advanced personal computer applications will require better interfaces, including speech input. "When you're not sure about something, you'll be able to ask, and when your system has some advice about how you can do something better, it will tell you," Tesler says.

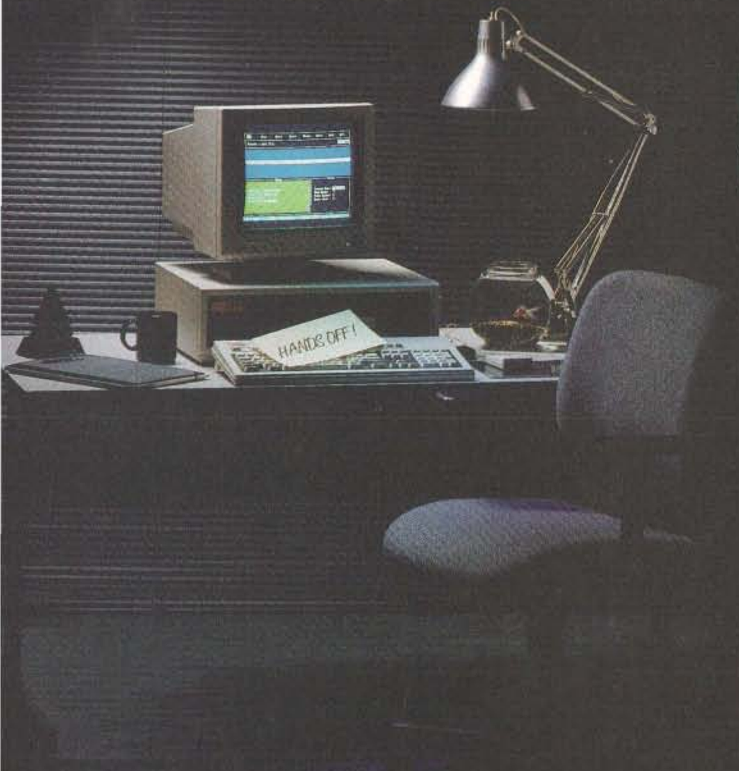
Interacting with your personal computer will change to "more of a dialogue, like what you might have with a colleague or assistant," he says. The microphone will become a standard feature of personal computers as speech input technology improves.

Apple says that's two or three years away. "It's pretty easy now to do single-speaker, limited-vocabulary recognition," says marketing director Michael Homer. "It's a lot more difficult to do a larger vocabulary—say, 2000 words of connected speech—where the system isn't trained to the particular speaker."

—Jeffrey Bertolucci

SEND US YOUR MICROBYTES. *Neural networks? Groupware? New laptop technology? New chips? If you, your company, or your research group is working on one of these exciting technologies or developing products that will significantly affect microcomputers and the way people work with them, please let us know. Phone us at (603) 924-9281. Or send a fax to (603) 924-2550. Or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. Or send E-mail to "microbytes" on BIX or to "BYTE" on MCI Mail. An electronic version of Microbytes, offering a wider variety of computer-related news on a daily basis, is available on BIX.*

NOW YOUR SOFTWARE CAN TEST ITSELF.



NOW AVAILABLE IN VGA

AND PS2!!

Your customers expect software that works. All the time. The key to software quality is exhaustive testing. It's also an engineer's worst nightmare. But it doesn't have to be. Because now you can automate your software testing.

Introducing the Atron Evaluator. The first and only non-intrusive automated PC-based software testing tool.

The Atron Evaluator automatically runs your software regression testing programs. All of them. All day. All night. Giving you thoroughly tested, higher quality software.

The Atron Evaluator is hardware-based. And since it's non-intrusive, software behavior is tested without the risk of alteration. Once your tests have run, you can refer to automatically generated test reports to double-check test results.

The Atron Evaluator saves time. And time makes you money. Development cycles are shortened, so your software gets to market sooner. And while your test programs are running, you can be more productive. Start a new project. Or go home.

For more information about the Atron Evaluator, call us at **1-800-283-5933.** And put an end to your worst nightmares. Automatically.

Circle 31 on Reader Service Card

atron

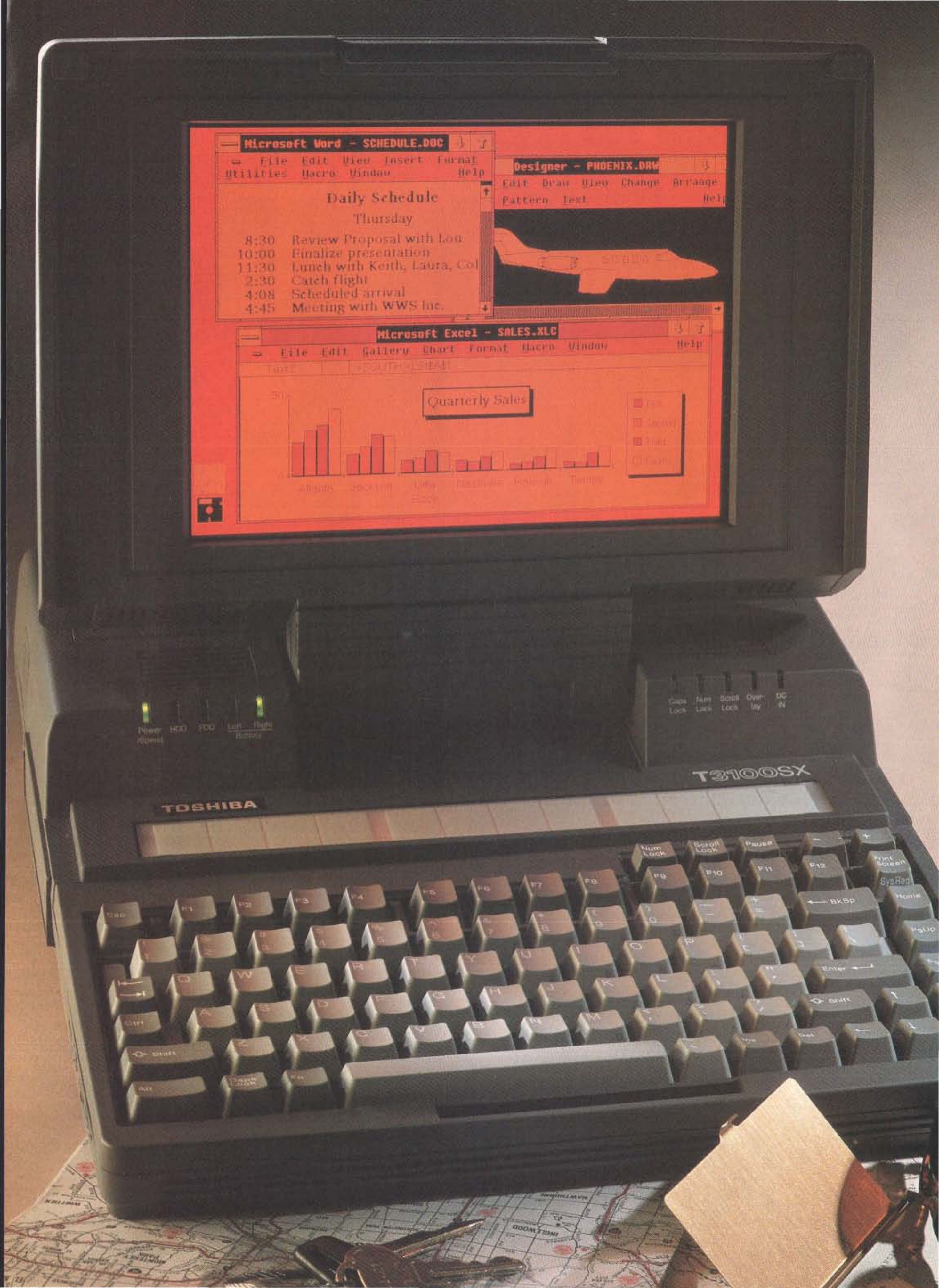
A Division of CADRE Technologies

Saratoga Office Center
12950 Saratoga Avenue
Saratoga, California 95070

In Europe, contact:

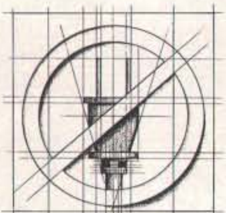
Elverex Limited, Enterprise House
Plassey Technology Park, Limerick, Ireland
Phone: 061-338177

QA Training Limited, Cecily Hill Castle
Cirencester, Gloucestershire, GL7 2EF, England
Phone: (0285) 5888


Microsoft Word - SCHEDULE.DOC
File Edit View Insert Format
Utilities Macro Window Help
Daily Schedule
Thursday
8:30 Review Proposal with Lou
10:00 Finalize presentation
11:30 Lunch with Keith, Laura, Col
2:30 Catch flight
4:08 Scheduled arrival
4:45 Meeting with WWS Inc.
Designer - PHOENIX.DRW
Edit Draw View Change Arrange
Pattern Text Help
Microsoft Excel - SALES.XLC
File Edit Gallery Chart Format Macro Window Help
Quarterly Sales
Power /Speed HDD FDD Left Right Battery
Caps Lock Num Lock Scroll Lock Over-lay DC IN
T3100SX
TOSHIBA

We've pulled the plug on 386SX technology.

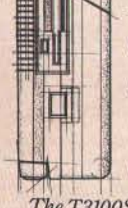
The top of a desk is no longer the only place 386-based computing gets done. That's because we've come up with a battery-powered alternative that works anywhere. It's known simply as the T3100SX.



Since the T3100SX is battery operated, you can utilize powerful 386 applications anywhere you choose.

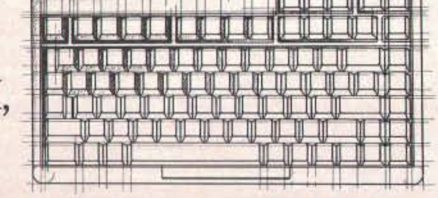
First of all, we gave it a powerful 386SX processor. So it can handle multitasking operating environments like Windows 386 and OS/2 with ease.

Next, we devised an ingenious display system unlike anything you've ever seen on a battery-powered portable. It combines both VGA and gas plasma technology, boasts a 100:1 contrast ratio and can support both an internal display and an external monitor simultaneously.



The T3100SX's slim case is only 3.15 inches thick and weighs just 14.9 pounds including its two standard batteries.

Finally, we gave it a 40MB hard disk, a 1.44MB 3.5″ floppy disk drive and 1 megabyte of RAM, which you can expand up to 13MB. All in an easy-to-carry, 14.9-pound package that goes wherever your work is.

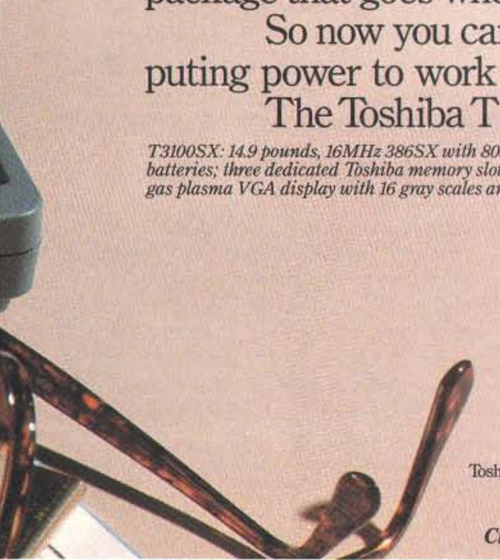


The ergonomically-designed 86-key keyboard features eight dedicated cursor control keys, 12 function keys and a numeric keypad.

So now you can put the latest 386 computing power to work for you, even if there isn't a plug anywhere in sight.

The Toshiba T3100SX. Take it. See how far you can go.

T3100SX: 14.9 pounds, 16MHz 386SX with 80387SX math coprocessor socket; 40MB hard disk with 25msec access, two removable, rechargeable batteries; three dedicated Toshiba memory slots, one dedicated Toshiba modem slot, one Toshiba general purpose slot; 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales and 100:1 contrast ratio; 1.44MB 3½″ diskette drive. For more information call 1-800-457-7777.



In Touch with Tomorrow

TOSHIBA

Toshiba America Information Systems Inc., Computer Systems Division

Circle 282 on Reader Service Card (DEALERS: 283)

LETTERS

and Ask BYTE


EDITORIAL ■ Fred Langa

THE LAST WORD ON THE SX?

An 80386SX-based computer isn't necessarily cheaper than an 80386 machine, or faster than an 80286

286 vs. 386SX vs. 386

The issue of the 386SX is not one of speed, but one of future compatibility and protecting your investment (Editorial, "The Last Word on the SX?," December 1989). Given a choice between an 8-MHz 386SX and a 25-MHz 286, I would put my money on the 386SX every time, because a fast 286 executes 386 code at precisely 0 MHz.

The 386SX, 386, and i486 CPUs have a common working environment and code that will finally give software a chance to catch up with the hardware, at least for a few years before the i586 hits the scene. While there might not be much 386-specific software now, the installed base is large enough to be worth the effort of developing it.

Bob Keates
Guelph, Ontario, Canada

Until recently, I would have agreed completely with editor in chief Fred Langa about the 386SX chip. As part of my job, I specify a lot of LAN workstations, and the one place where I suddenly find myself choosing the 386SX is for running Microsoft Windows. The reason is memory management. With the 386SX, I can use plain old extended RAM and the Quarterdeck Expanded Memory Manager to get what would otherwise require expensive hardware-enhanced EMS.

The 386SX machines I end up with aren't as fast as similarly priced 286s, but the memory handling makes up for it, at least under Windows. However, I continue to specify 286 systems, too.

Jeff Sloman
Boston, MA

If you substitute 386 for 386SX in your letter, I will agree completely. There are many valid reasons for opting for a 386 over a 286—memory management being one of them. My editorial was not anti-386—not at all. But it was *anti-386SX. If you need 386 capabilities (and it sounds like you do), then a "real" 386 is usually the way to go. The 386SX is a crippled 386. Why buy it, especially when many vendors still charge a premium for it?*

—Fred Langa

Hugh's Reviews Reviewed

Hugh Kenner's column on A. K. Dewdney's *The Turing Omnibus* (Print Queue, December 1989) carries much more punch than that of a review. Kenner offers a historical perspective that could only come from one who has a broad background in both computer science and mathematics.

John M. Ward
Augusta, GA

I'd like to make a few comments on Hugh Kenner's review of *The Turing Omnibus*. First, 3 is not the first prime number. Unfortunately, 2 is. Many theorems begin with, "For all odd primes. . . . . "

Second, G. H. Hardy's use of the word *useless* to describe number theory was a very restrictive use of the term. *Useless*, in Hardy's sense, meant that one couldn't use number theory as a tool of war. How wrong he was.

Finally, I wonder what Kenner meant by the phrase, "what universities fund as 'mathematics.' " Perhaps Kenner works in a department that universities fund as "English."

Wayne Moore
Gaylord, MI

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the page and include your name and address. We can print listings and tables along with a letter if they are short and legible. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

Because of space limitations, we reserve the right to edit letters. Generally, it takes four months from the time we receive a letter until we publish it.

Don't Forget Amiga

Regarding Don Crabb's "A Tale of Two Operating Systems" (December 1989), I would rewrite the last part of the second sentence to read, "You can pick and choose from a variety of powerful computer systems—IBM PC or Macintosh *or Amiga*—and at prices less than a king's ransom." I would add that if you want high-resolution color graphics, true multitasking, and more than a nickel left in your bank account, you should choose the Amiga. The Mac will display a bazillion colors more than the Amiga 4096, but you'll pay dearly for it. And the Mac does not really perform multitasking. OS/2 does, but, again, you pay a great price for what you get.

Barry E. Holsinger
Sunnyvale, CA

Flap over Kurzweil's Flap

I was surprised by Raymond Kurzweil's use of the term "alveolar flap" in his article on automatic speech recognition (ASR) ("Beyond Pattern Recognition," December 1989). He states that we all have an alveolar flap that turns on and off nasality in human speech.

An alveolar flap is an acoustic event, not a piece of anatomy. An alveolar flap is the sound made by tapping or flapping the tip of the tongue against the alveolar ridge behind the top front teeth while the vocal chords are vibrating, producing the sound represented by "dd" in "ladder."

The anatomical part that opens and closes the air passage between the oral and nasal cavities is the nasal side of the velum (also called the "soft palate").

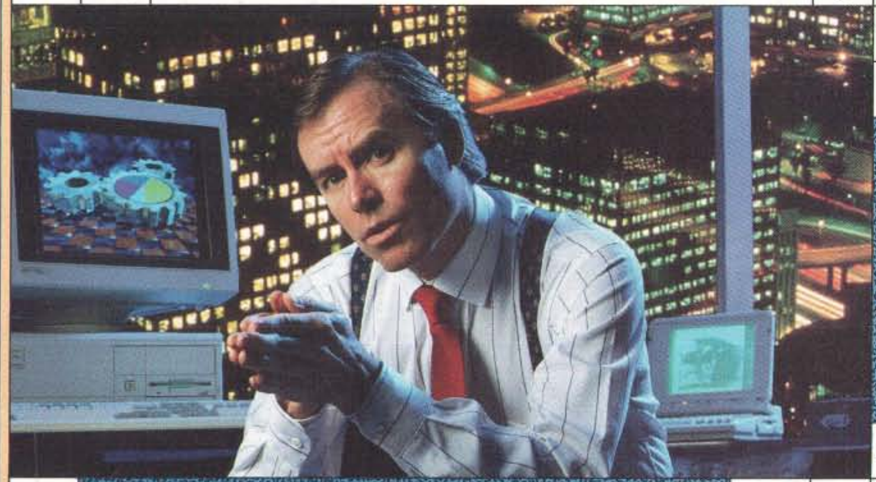
In addition, phonemes are not speech sounds, as Kurzweil says. A phoneme is an abstraction, a symbol for a category of one or more speech sounds (phonetically similar if more than one) called "allophones." A phoneme represents a minimal sound difference that can signal a meaning difference. Substitution of one allophone for another of the same phoneme may sound peculiar, but it does not signal a change of meaning.

I found Kurzweil's article and the

continued

"It's great to have a 386SX system that's ready for the future.

"And it's even more appealing when I can save $200 right now."



ZENITH DATA SYSTEMS INNOVATES AGAIN™

The SX Appeal deal—$200 instant savings on our Flat Technology Monitor when you buy our Z-386SX or SupersPort® SX.

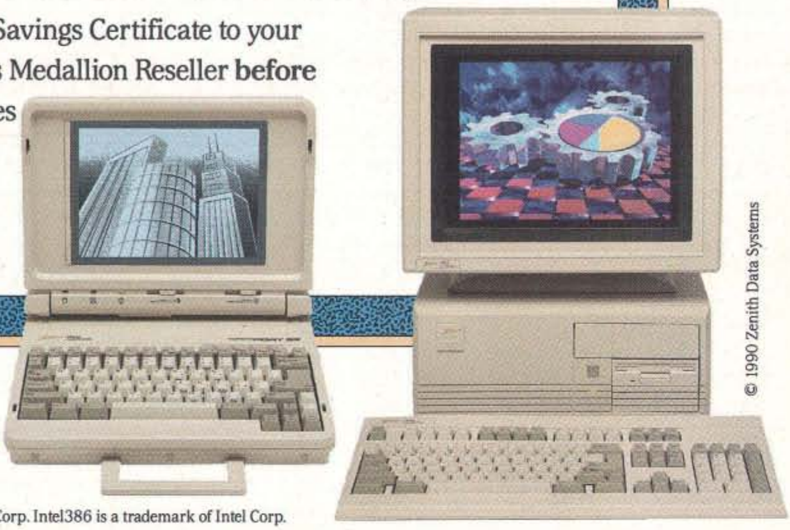
SX Appeal™

Why does the Intel386SX™ microprocessor have so much appeal? It not only handles today's advanced applications, but assures compatibility with emerging software designed for graphical user interfaces—all with the affordability of a 286-based PC. And now for a limited time only, you can take advantage of our special *SX Appeal* deal.

Choose our Z-386 SX desktop PC that maximizes 386SX performance for ultra-fast processing speed. Or our SupersPort SX laptop PC with its *Page White* VGA display. Then for each system purchased, you'll receive **$200 savings** on our award-winning Flat Technology Monitor—the revolutionary non-glare VGA color monitor with unsurpassed clarity that's the perfect match for graphical interfaces. This offer also applies to all our 386-based desktops and VGA laptops.

Just bring the attached $200 Savings Certificate to your participating Zenith Data Systems Medallion Reseller **before June 1, 1990.** Additional certificates are available at each location. For the location nearest you, call:

1-800-227-4617
U.S. and Canada



ZENITH data systems
Groupe Bull

© 1990 Zenith Data Systems

Graphics simulate Microsoft® *Windows*, a trademark of Microsoft Corp. Intel386 is a trademark of Intel Corp.

Circle 301 on Reader Service Card

others in the In Depth section on sound and image processing very interesting. I once predicted that someday we'd reform our spelling in English to accommodate natural language processing (that prediction is as yet unfulfilled, of course). Now that commercial ASR systems require pauses between words, I suggest (but not predict) that we might change our manner of speech, pausing briefly between words, to accommodate ASR.

James L Wyatt, Chairman
Dept. of Modern Languages and Linguistics
Florida State University
Tallahassee, FL

Helping the GUI User

If William Lee ("Heard It Through the Help Line," December 1989) thinks that giving customers advice over a help line is a nightmare with a textual interface, he should appreciate what I heard outside an office that had just installed Macs.

"Just a minute. I'll put you on the speakerphone. I can't balance a headset, type, and run the mouse at the same time!"

Voice on the phone: "Run the little mousey over the thing that looks like a praying mantis that got ironed in your shirt pocket. Go clicky, clicky. Did he turn into a new menu or that old flatiron thing again?"

"Neither. I think it's a shot glass."

"That's just wishful thinking. Could it be a wastebasket? One of those old wire ones?"

"What does a wire wastebasket look like?"

"Are you under 30? Did you ever see an old movie with a reporter's office? They always had one by the desk."

"Yeah, so what? Do you have to be over 40 to work this thing? It took me 15 minutes to figure out that the clockface wasn't a pie. I own a digital watch, like everyone else. Now I gotta know all about old movies to recognize these stupid pictures!"

"Go clicky, clicky on the shot glass and tell me if it turned back into the flatiron thing. If not, look for a real shot glass after work."

Joe Celko
Los Angeles, CA

You're Welcome

Thanks for starting David Fiedler's Unix /bin column. With Unix coming into play more and more in the workplace, it's a much-needed, gentle introduction to the subject. Keep it up.

Louis M. Pecora
Washington, DC

ASK BYTE

Too Much Protection

I am trying to run a program that I received with my Penman plotter almost two years ago, but a special security feature built into it has prevented me from doing so.

The name of the program is PENPLOT.EXE. The documentation failed to mention that I could make only one backup copy. It was clear, however, that the program had to be executed on the original disk. In the process of trying to redeem the situation, I also overwrote the original file (or else it automatically locked itself when I made a second backup copy).

Having looked at the executable file with my PCTOOLS file editor, I know that it is an unpublished work by the Vault Corp. I have been unable to find an address for the company, and Penman has gone out of business. Is it possible for me to defeat the backup security? It displays "Unauthorized Duplicate" any time I run Penplot on the original disk or either of the backups.

Larry D. Elliott
Moscow, ID

You're not the first person to have this problem, and I doubt that you'll be the last. Yes, it's possible to defeat the copy protection on your software, but making pirated copies of software is illegal and a practice that we at BYTE disapprove of. But with Vault's copy protection, it is often unnecessary.

Vault's scheme uses a physical mark on the floppy disk. You can reformat the disk, copy your software back onto it (from your backup), and the disk should be as good as new.

For obvious reasons, I won't tell you how to break Vault's scheme here, but I can tell you that several software utilities are available that will make copies of your disks. Before you spend your money, I suggest that you contact Vault's technical-support department (505 West Olive Ave., Suite 330, Sunnyvale, CA 94086, (408) 737-8474). The people there are very nice, and as long as you're holding a legitimate copy of the software, I'm sure that they'll be glad to help you out.

—H. E.

The Educated Computer

I am studying educational administration, and the theme for my upcoming thesis is "Computer-Assisted and Support Instruction—Its Planning, Implementation, and Evaluation." Could you suggest any source of information on this topic (including any computer software that is available)?

Oralia Eugenia Machuca Vaca
Mexico City, Mexico

First, I suggest that you explore your university library to see if it carries the Journal of Research on Computing in Education. *If not, you may be able to obtain a subscription (either through your department or the library) by contacting the International Association for Computing in Education, 1230 17th Street NW, Washington, DC 20036.*

As far as software goes, the public domain world is filled with educational and educational-support (which I take to mean record-keeping, student tracking, and so on) software. Try the Buyer's Mart at the back of BYTE and order a few catalogs.

Finally, here is a list of some books you can look for that describe specific instances of using computers in upper-level courses: APL Programs for the Mathematics Classroom *by Norman Thompson (Springer-Verlag, New York, 1989);* Calculus and the Computer *by William F. Oberle (Addison-Wesley, Reading, MA, 1986); and* Using Computers in Physics *by John R. Merrill (Houghton Mifflin, Boston, MA, 1976).*—R. G.

Speaking of Speech Recognition

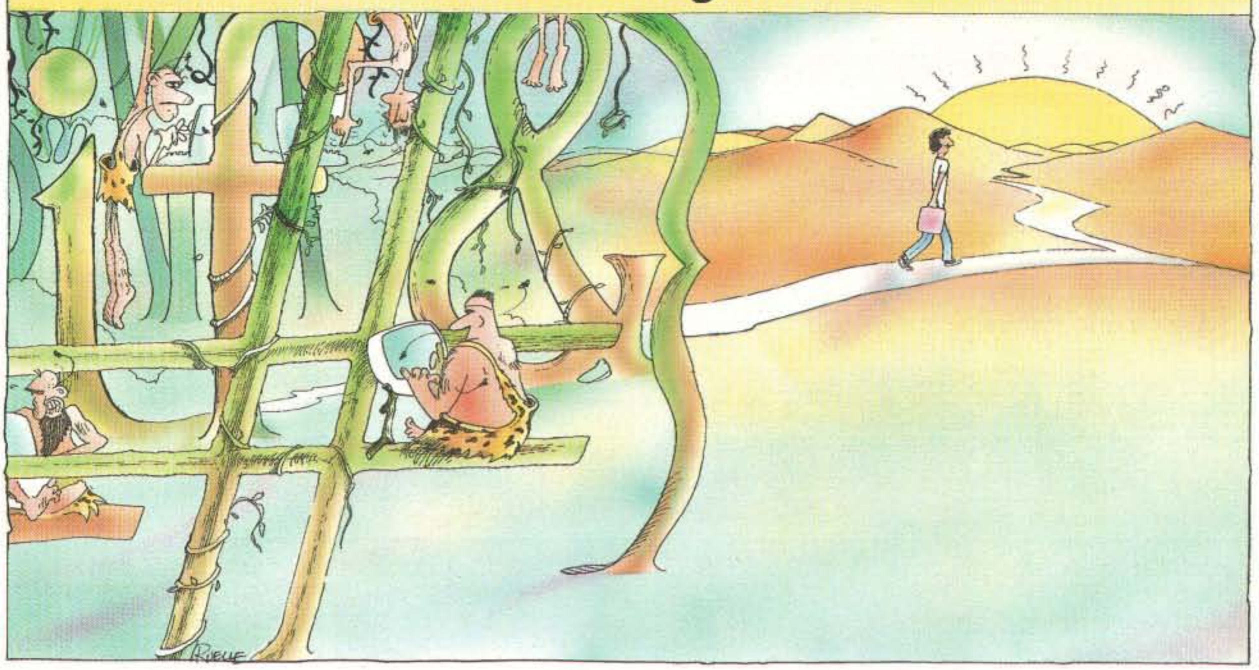
In the December 1989 Ask BYTE, David R. Brammer wrote asking about speech recording and playback hardware for the PC. Shortly afterward, we received a press release describing SoftSpeak, a software product from Quantech Ltd. SoftSpeak allows a 10-MHz PC (or any AT or PS/2) to produce speech through the standard speaker; no additional hardware is required. Mr. Brammer, if you're reading this, contact Quantech Ltd., 2a West View, Forest Hall, Tyne & Wear, NE12 0LJ, UK, 091-266-7007.

—Lab Staff

FIXES

- The mapping algorithm shown in "Configuring Parallel Programs" (December 1989) was developed by Shahid H. Bokhari for the Finite Element Machine, which was an early microprocessor array at the NASA Langley Research Center.
- The correct telephone number for Zenith Data Systems ("Zenith's EISA Does It," February) is (800) 553-0331. ■

Great Moments in C-Programmer Evolution



Code-dweller emerges from the jungle

"It's a jungle in there," said the programmer looking at the code for the ser interface of an application. "Every year gets worse."

Don't despair. Finally, there is a way out. ermont Views™ 2.0.

From Complexity to Simplicity

Vermont Views 2.0 replaces the complexi-es of interface coding with the simplicity of ne **Vermont Views Designer**. This powerful nteractive forms designer works in concert vith our comprehensive library of over 550 unctions to make interface development nd management quicker and easier than ver before.

Development Will Never Be the Same Again

With the Vermont Views Designer you will uickly create operational prototypes of an pplication interface—and enjoy doing it! ecause design is fast and visual, you will nvolve your clients actively from the begin-ing. Last-minute change requests will be ccepted without battles or escalating costs.

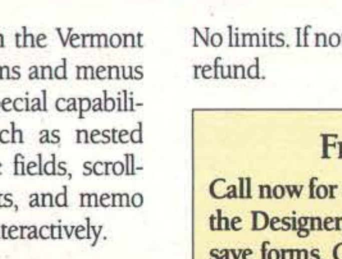
No longer will you throw away months of

prototype code—the prototype will become the implementation. And, integration and final esting will go faster, because all Designer objects re tested for validity as they are created.

No More Maintenance Blues

Software maintenance typically accounts for over 50 percent of total lifecycle programming effort—and a higher percentage of headaches. With the Vermont Views Designer, you will always be able to revise the interface quickly and easily, seeing the changes as you make them.

The Vermont Views Difference



Screen generators for most C libraries require you to modify generated source code to create fully functional forms—after which you can no longer use the screen generator. Not so with the Vermont Views Designer. Designer forms and menus can incorporate any of the special capabilities of Vermont Views—such as nested menus, scroll bars, tickertape fields, scrollable form regions, choice lists, and memo fields—and still be revised interactively.

Message from the Jungle

"At a recent field staff meeting, we were able to get a consensus on what forms should look like by using the Designer on a big screen TV. Changes can be posted real-time, and a functioning prototype results from the exercise. The form designer is GREAT."

—Randy Jones, Beta Tester

Globally Applicable

Use Vermont Views with any database or file manager with a C-language interface, such as Oracle, Informix, dBase, Clipper, dbVista, Btrieve, and C-tree. Maintain the same interface with the same source code under DOS, OS/2, UNIX, XENIX, and VMS.

Create interfaces for any roman-based language. Truly a global solution for your interface needs.

100% No-Risk Guarantee

We believe in our product. Try Vermont Views for as long as you want. No limits. If not fully satisfied, return for a full refund.

Free Test Drive

Call now for a free DOS working copy of the Designer, lacking only the ability to save forms. Get out of that jungle!

Call **800-848-1248**
Fax **802-848-3502**

Vermont Creative Software

Pinnacle Meadows, Richford, VT 05476
Phone: 802-848-7731 Telex: 510-601-4160

A 386SX for Less Than $1000

The generically named 80386SX from Acma Computers includes a 16-MHz CPU, 1 MB of RAM (expandable to 8 MB), an American Megatrends BIOS, a 5¼-inch 1.2-MB or 3½-inch 1.44-MB floppy disk drive, a floppy/hard disk drive controller, and five 16-bit and two 8-bit expansion slots.

The chassis is either the small-footprint or standard AT size, respectively measuring 6½ by 17 by 16½ inches and 6½ by 21 by 16½ inches. The small-footprint version can hold one 3½-inch and three 5¼-inch half-height floppy disk drives. The standard-size system has room for five half-height 5¼-inch drives.

The VGA Executive Package includes color VGA graphics necessities, a printer, and printer accessories. Inside the computer, Acma supplies a 40-MB 28-ms hard disk drive and a 16-bit color VGA card. The package also includes a color VGA monitor and a Panasonic 1191 printer. Printer accessories include a cable, a stand, a surge protector, 10 disks, and computer paper.

Price: $995; VGA Executive Package, $2245.

Contact: Acma Computers, Inc., 117 Fourier Ave., Fremont, CA 94539, (800) 666-8898 or (415) 623-1212.

Inquiry 1121.

Acma's 80386SX has all the basics and is expandable.

386SX Portables Come with Cellular Phones

Intelligence Technology has introduced two 386SX-based portables with removable cellular telephones that you can use for voice communication or for 2400-bps data communications.

The ITC 386 CEL and XCEL (for extra-lightweight cellular) systems both feature a built-in keyboard and monochrome VGA display, an MNP modem, and standard I/O ports. Power on both models comes from a removable 7.2-V rechargeable battery pack or any 12-V connection.

Weighing 9½ pounds (with telephone), the XCEL has 2 MB of RAM and a 20-MB hard disk drive. It measures 2½ by 12 by 11¾ inches.

The 15-pound (with telephone) CEL offers 4 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, a 40-MB hard disk drive, one 16-bit expansion slot, a full-size keyboard with a numeric keypad, and a built-in speakerphone. It measures 3⅓ by 13 by 12⁹⁄₁₀ inches.

Price: XCEL, $7495; CEL, $8695.

Contact: Intelligence Technology Corp., 16526 Westgrove, Dallas, TX 75248, (800) 356-3493 or (214) 250-4277.

Inquiry 1122.

Inexpensive Desktops and a Laptop

Emerson Computer has introduced three inexpensive ATs: two desktops and a laptop.

The 8200 is a 12.5-MHz 286 small-footprint desktop system. It has 640K bytes of RAM (expandable to 4 MB on the motherboard), five 16-bit full-length slots, a CGA controller, two 3½-inch disk drive bays (one internal), an Integrated Drive Electronics (IDE) hard disk drive controller, a 101-key keyboard, a 5¼-inch 1.2-MB floppy disk drive, and bundled software.

The 16-MHz 826ECV desktop ups the ante with 1 MB of RAM and a VGA controller but has only three full-length expansion slots.

The 550LTV laptop has a 12-MHz 286 CPU, a monochrome VGA controller, a 10-inch backlit VGA monitor, 1 MB of RAM (expandable to 4 MB), a socket for an 80287 math coprocessor, a 3½-inch 1.44-MB floppy disk drive, and a 20- or 40-MB hard disk drive. The laptop weighs 14 pounds without the hard disk drive but with the battery (which is good for 3 hours between charges).

Price: 8200, $1349; 8200 with 20-MB hard disk drive, $1669; 8286ECV, $1699; 550LTV with 20-MB drive, $2499; 550LTV with 40-MB drive, $2699.

Contact: Emerson Computer Corp., 5500 East Slauson Ave., Commerce, CA 90040, (213) 722-9800.

Inquiry 1120.

Cellular phones let you talk from your ITC laptops.

The Shape of Monitors to Come

The Finlux ELM 640.350 is a compact flat-panel monitor that gives you yellow-on-black EGA (640- by 350-pixel) graphics and three levels of gray with electroluminescent display technology.

The ELM weighs only 3 pounds, measures $9\frac{4}{5}$ by $7\frac{9}{10}$ by $2\frac{4}{5}$ inches (with a display area of $4\frac{4}{5}$ by $7\frac{1}{10}$ inches), and has a movable arm and table stand. Finlux says that the monitor emits no magnetic or electrical radiation and that it uses only 25 W, which is about one-fourth the power consumption of a normal CRT.

Price: $1595.
Contact: Finlux, Inc., 20395 Pacifica Dr., Suite 190, Cupertino, CA 95014, (408) 725-1972.
Inquiry 1128.

The Finlux ELM 640.350 monitor has a movable arm and table stand.

Two-Page Display for a Mac or PC

The Radius TPD/21 is a high-resolution 21-inch two-page monochrome/gray-scale display system for your PC compatible or Mac SE, SE/30, or II.

The flat-screen monitor features a maximum Macintosh resolution of 1152 by 882 pixels (effectively, 74 dpi) and a 71-Hz refresh rate. If you're using a PC, the refresh rate is 65 Hz and resolution is 1280 by 960 pixels.

Included in the price of the monitor is RadiusWare software for menus and drivers for DOS applications and for VGA-compatible applications. The video-controller card is optional.

Price: $1795; TPD/PC controller, $795; TPD/Mac controller, $595; GS/C controller for Mac II, $1895.
Contact: Radius, Inc., 1710 Fortune Dr., San Jose, CA 95131, (408) 434-1010.
Inquiry 1127.

Epson's New Wide-Carriage 24-pin Printer

The LQ-1010 is an inexpensive 24-pin letter-quality printer with a carriage wide enough for 136-column printing.

Features include print speeds of 180 cps in draft mode and 60 cps in letter-quality mode, bidirectional printing in text mode, a slot for optional font modules, an 8K-byte buffer, built-in push-tractor feed, and automatic single-sheet loading. There's also a SmartPark paper-handling feature and 360- by 360-dpi graphics resolution.

Standard equipment also includes five resident fonts, four print speeds, and six character sets. The printer has a parallel interface, measures $5\frac{2}{3}$ by $23\frac{1}{3}$ by $13\frac{2}{3}$ inches, and weighs 18 pounds.

Price: $699.
Contact: Epson America, Inc., 2780 Lomita Blvd., Torrance, CA 90505, (800) 922-8911.
Inquiry 1129.

SEND US YOUR NEW PRODUCT RELEASE

We'd like to consider your product for publication. Send us full information, including price, ship date, and an address and telephone number where readers can get further information. Send to New Products Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Information contained in these items is based on manufacturers' written statements and/or telephone interviews with BYTE reporters. BYTE has not formally reviewed each product mentioned. These items, along with additional new product announcements, are posted regularly on BIX in the microbytes.sw and microbytes.hw conferences.

Mondo Storage for Unix Fans

The MO Floppy drive for Unix systems features rewritable and removable 640-MB magneto-optic cartridges and is implemented on The Santa Cruz Operation's Unix 386/V operating system.

MO Floppy is based on Sony's SMO-S501 magneto-optic drive. You plug it into the host system via the included 1542A 16-bit SCSI controller by Adaptec.

Each MO Floppy includes a SCSI driver and operating software. The user interface has commands for formatting new cartridges and for copying files.

Price: $7999.
Contact: Software Horizons, Inc., 501 McDonald Rd., Aptos, CA 95003, (408) 684-1375.
Inquiry 1130.

This Keyboard Is Designed for 3270 Applications

The 122-key KB 3270 Plus keyboard from Key Tronic has an 8K-byte RAM chip for IBM 3270 terminal emulation. It's plug-compatible with PCs, and an adapter is available for PS/2s.

Two main features are ScanEdit and ScanLoad, with which you can reprogram all 122 keys. Supported applications include Attachmate, Attachmate Extra, IBM 3270 Workstation, IBM 3270 Emulation, IRMA, IRMA/2, IRMAX Multisessions, Novell NetWare 3270, and PCOX.

Price: $349.
Contact: Key Tronic, P.O. Box 14687, Spokane, WA 99214, (509) 928-8000.
Inquiry 1131.

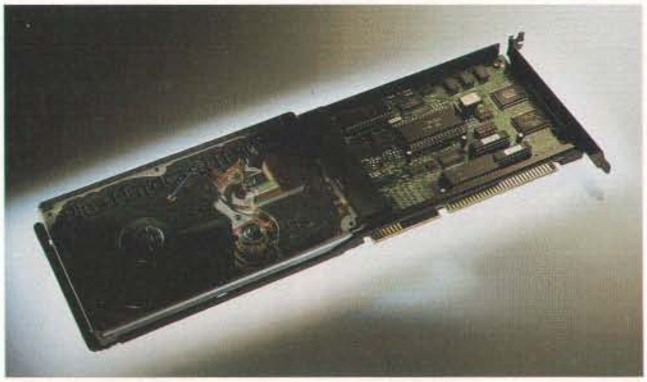
continued

Plus Development's Hardcard II Features 64K-byte Cache

Plus Development has announced a revamped version of its hard-disk-on-a-card product, Hardcard. The company says that the Hardcard II offers better performance but is designed to work only with 286- and 386-based systems.

Hardcard II comes in two models: the Hardcard II 80 and the Hardcard II 40, holding 80 and 40 MB of data, respectively. Both cards are full-length, single-slot cards that do not obscure other slots.

Both cards use 3½-inch hard disk drives and integrate a full 16-bit drive controller on the card. In addition, both use 1-to-1 interleaving and have an on-board 64K-byte cache to give them an effective access time of 19 ms, according to the company.



Each Hardcard II features a hard disk drive.

Hardcard II also features Plus Development's firmware to transparently trap bad sector information and map data elsewhere on the disk to minimize data loss.

Price: Hardcard II 40, $849; Hardcard II 80, $999; the company has also reduced prices of the original Hardcards to $749 (20-MB model) and $849 (40-MB model).

Contact: Plus Development Corp., 1778 McCarthy Blvd., Milpitas, CA 95035, (408) 434-6900.

Inquiry 1132.

Controller Doubles Your Hard Disk Capacity

Perstor says that its new ADRC-9008 hard disk drive controller, a half-length 8-bit card, almost doubles the capacity of modified frequency modulation (MFM) hard disk drives and significantly increases the capacity of run length limited (RLL) drives.

To achieve such dramatic increases in capacity, the controller writes to 32 sectors per track (MFM usually uses 18 sectors, and RLL, 26). To keep errors from occurring more often, Perstor uses a proprietary 56-bit error-correction code that doesn't increase flex reversals.

The ADRC-9008 supports two hard disk drives. Any ST506/ST412 drive type with up to 1024 cylinders and 15 heads will work. For installation, Perstor provides a BIOS-resident autoconfigure setup and low-level formatting program.

The controller supports variable interleaving and operates at 9 Mbps. It has an 8-bit bidirectional bus-host interface but will operate in 286 and 386 systems.

Price: $199.

Contact: Perstor Systems, Inc., 1335 South Park Lane, Tempe, AZ 85281, (602) 894-3494.

Inquiry 1133.

continued

Input and Manipulate Motion Video in Windows

You can now inexpensively input and manipulate full-motion video with your AT in Windows on your standard VGA monitor.

The DVA-4000/ISA works with today's analog technologies, such as videodisk, satellite feed, off-air TV, and video camera, and with digital storage technologies such as Digital Video Interactive (DVI), CD-I, and CD-ROM/XA.

The manipulation of these images requires a wider data path than is available on XT and AT computers. So VideoLogic designed the 32-bit Video Logic Media Bus, which can potentially support daughterboards.

Features of the ISA board include display at 30 frames per second (or, for PAL, 25 frames per second); software-controllable picture content (e.g., hue, saturation, contrast, and brightness); video, audio, and graphics mixing; image capture on magnetic or optical media; two switchable input sources; video windowing, scaling, and positioning; pictures within pictures; and multiple live video windows.

Price: For ISA or Micro Channel, $2495.

Contact: VideoLogic, Inc., 245 First St., Cambridge, MA 02142, (617) 494-0530.

Inquiry 1134.

VideoWindows now integrates full-motion frame grabbing and VGA graphics overlay in Microsoft Windows and HP NewWave environments, according to New Media Graphics.

The AT-compatible board with an 80188 microprocessor continuously digitizes NTSC or PAL video signals in a frame buffer, which you can manipulate or position anywhere on the screen in real time. The full-motion (or still-frame) image that results is then converted back to an analog signal, decoded in RGB, combined with VGA or EGA graphics, and then displayed on your noninterlaced 60-Hz RGB monitor. You can also store images on a disk to be manipulated or displayed later.

Features include overlay with VGA graphics, in any proportion of graphics or video; automatically locking onto VGA with up to 256 colors at 640 by 480 pixels; zoom functions from 65 percent to 200 percent; image compression to one-fourth and one-sixteenth of the screen; image storing in VideoWindows, PCX, or TARGA file formats; cutting and pasting portions of video into graphics screens; panning horizontally and vertically and fading in and out; programmable picture attributes like hue, saturation, intensity, comb filter, coring, and sharpness; and up to two simultaneous inputs (from broadcast TV, videotape, videodisk, still video camera, live video camera, cable, and satellite).

Price: $1795; Microsoft Windows driver, $195.

Contact: New Media Graphics, 780 Boston Rd., Billerica, MA 01821, (508) 663-0666.

Inquiry 1135.

DBMS Case Study:

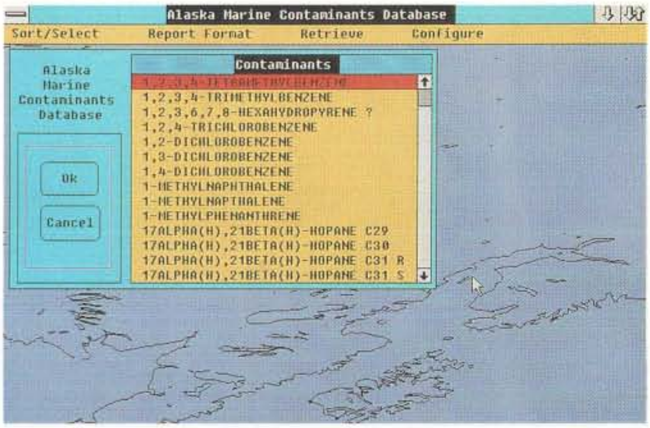
The Exxon Valdez Disaster

March 24, 1989. Exxon VALDEZ tanker runs aground, creating the worst oil spill in U.S. history. 11,000,000 gallons contaminate the pristine waters of Alaska's Prince William Sound.

The Problem Major disasters, like the Exxon Valdez spill, require quick response based on careful data analysis. Fortunately, an easy-to-use database was already being created which would help.

The Application The Alaskan Marine Contaminants Database lets oceanographic chemists easily access 60 megabytes of data covering the past decade. The database is provided free of charge on CD-ROM, and the Windows interface means they can get right to work, assessing damage to the ecosystems of Prince William Sound and other Alaskan waters.

The Solution db_VISTA III is the only DBMS with the features this project required: C language support, Windows compatibility, royalty-free runtime distribution, quick performance in large databases, quality documentation and support. With the Alaskan Marine Contaminants Database, the difficult job of calculating the long-term effects of the Exxon spill is a little easier.*



A Microsoft Windows front end lets chemists select regions from a map to retrieve data. And, db_VISTA III's SQL-based query and report writer lets users perform complex SQL data searches.

Your DBMS problems may not make the headlines, but they are no less important and often no less challenging. If you develop applications for MS-DOS, MS Windows, UNIX, VMS, QNX, OS/2, Macintosh, and other environments, db_VISTA III is your solution.

Call 1-800-db-RAIMA (1-800-327-2462)

* Reprints of the story, as published in PC Week and Data Based Advisor, are available from Raima.

db_VISTA III™

Database Management System

Specifications: ***Complete C source code available. No Royalties C Lanaguage Portability & High performance***

Network Data Model. Relational B-tree indexing. Relational SQL query and report writer. Single & Multi-user. Automatic recovery. Built-in referential integrity. Complete revision capability. **Supports:** MS-DOS, MS Windows, UNIX, QNX, SunOS, XENIX, VMS, Macintosh. OS/2 compatible. **Most C Compilers supported. LANs:** 3COM, Novell, Banyan, Appleshare. Call for other environments.

Power Tools For C Programmers

RAIMA™ CORPORATION

db_VISTA III DBMS rated number #1

For Performance and Flexibility of DBMS Programming Tools- **PCWEEK** Poll of Corporate Satisfaction, August 28, 1989.

Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA **(206)747-5570** Telex: 6503018237 MCI UW FAX: (206)747-1991
International Distributors: **U.K.**: (0992) 500919 **Germany**: 07127/5244 **Switzerland**: (01)725 0410 **Netherlands:** (02159)46 814 **Sweden**: (013)124780 **Italy:** 045/584711 **Norway**: (02) 44 88 55 **Denmark**: 2887249 **U.S.S.R.:** (812) 292-1965, (0132) 35-99-08 **Australia:** 02 419 7177 **Japan**: (03)473 7432 **Taiwan**: (02)511 3277 **Mexico**: (83) 57 35 94 **Central America**: 506 28 07 64 **Argentina**: 1 313 5371 **Chile**: 2 696 4308 **Uruguay**: 2 92 0959

Circle 243 on Reader Service Card

BY040

FOR $1899, YOU CAN GET A LOT OF COMPUTERS.

A Mouse in Disguise

The MousePen is a Microsoft Mouse-compatible input device with two input buttons and ballistic control, yet you hold it like a pen and you don't need a mouse pad.

Inside the head of MousePen is a miniature mouse. The buttons are positioned for clicking with your index finger; the bottom button is the "point" or traditional "left" button. Resolution is 50 to 1000 dpi, and tracking speed is 18 inches per second. MousePen measures $\frac{7}{10}$ by $\frac{3}{5}$ by $6\frac{1}{10}$ inches. Without the PS/2 cable or the serial cable for XTs and ATs, MousePen weighs 32 ounces.

Pop-up TSR menus for Lotus 1-2-3, dBASE III, and WordPerfect are included in the 10K- to 30K-byte main program. Also included is TelePaint, a color paint program with VGA support.
Price: $129.
Contact: International Machine Control Systems, Inc., 1332 Vendels Cir., Paso Robles, CA 93446, (800) 448-1184 or (805) 239-8976.
Inquiry 1138.

The Microsoft Mouse-compatible MousePen offers you all the standard features.

Da Vinci Graphics Creates Penless Plotter

Da Vinci Graphics' new RasterPro 720 "penless plotter" looks much like a laser printer and operates eight to 10 times faster than conventional pen plotters. The RasterPro 720 uses a bidirectional print head and a four-color fabric ribbon.

Inside the plotter is a 68000 microprocessor and technology for converting vector-based plotter instructions to a raster printing format. Print resolution is 720 dpi, and the interfaces are parallel and serial.

The RasterPro 720 produces A-size ($8\frac{1}{2}$- by 11-inch) or B-size (11- by 17-inch) images. Unlike conventional plotters, the RasterPro 720 offers a high-speed draft mode at either 180 or 360 dpi in color or monochrome.

The RasterPro 720 weighs 27 pounds and measures $4\frac{3}{4}$ by $22\frac{4}{5}$ by $13\frac{3}{5}$ inches.
Price: With 512K bytes of RAM, $3495; with 2 MB of RAM, $3995.
Contact: Da Vinci Graphics, Inc., 870 Hermosa Dr., Sunnyvale, CA 94086, (408) 737-8800.
Inquiry 1137.

Measure Horizontal Frequencies on CRTs

Scan-Mate is a hand-held device that measures your monitor's horizontal frequency or the horizontal frequency of a video projector, using the magnetic fields that CRTs emit. It can measure monitors with screens as small as 9 inches or as big as 35 inches and display frequencies from 0 to 70 kHz. Power comes from a standard 9-V battery.
Price: $250.
Contact: Inline, Inc., 625 South Palm St., La Habra, CA 90631, (800) 882-7117 or (213) 690-6767.
Inquiry 1142.

continued

Spoken to Your Spreadsheet Lately?

The Voice Master Key System II is a small external box that lets you add voice commands to DOS applications, thus replacing repetitive keystrokes or extensive mouse movements with macro voice commands. The interface is your parallel printer port, and there's a pass-through function that lets you keep your printer attached.

A TSR program is included that occupies about 64K bytes of RAM (or you can order an EMS version that requires only 6K bytes of main memory). It's compatible with such programs as Lotus 1-2-3, AutoCAD, WordPerfect, dBASE III, and SideKick.

You teach it words by saying them twice and typing the prompt and the desired response. Other users can subsequently repeat the list of macros in their own voices and save additional voice templates to memory.

The program is divided into 16 levels, which can correspond to 16 different software packages. You can store up to 16 macros in each level, with a macro as short as one keystroke or as long as 250. Any one of the maximum 64 voice commands can be assigned to activate a macro in any of the 16 levels, so a single voice command can have different meanings in different software applications, for example.

Other features include adjustments for recognition modes and sensitivities, testing sequences to adjust for background noise, display of your macros within applications, and recording and sending voice memos over networks (with Voice Master Systems on each voice-memo workstation).

Also included is developer software for speech and sound recording and editing. Editing software lets you edit sounds for use in software programs or in external EPROMs. It allocates 64K bytes of RAM for input, variable to 576K bytes of RAM with data file links.
Price: $219.95.
Contact: Covox, Inc., 675-D Conger St., Eugene, OR 97402, (503) 342-1271.
Inquiry 1140.

Get the latest Word from SCO.

Microsoft Word 5.0 for UNIX Systems.

You've come to depend on SCO™ for the latest UNIX® System software solutions for PCs. Industry standards such as SCO™ XENIX® 386 and SCO UNIX System V/386 Release 3.2. World-famous applications such as SCO Professional,® the 1-2-3® workalike, and SCO™ FoxBASE+.™

And now Microsoft® Word 5.0, the same full-featured word processing system that has defined power, speed and flexibility for MS-DOS® and OS/2™ users, is also available for SCO XENIX and UNIX Systems!

Microsoft Word 5.0 joins SCO's powerful team of multiuser business applications.

It's multiuser and multitasking. And it's ready to give you true workgroup benefits while maintaining keystroke and file compatibility with Word for MS-DOS and OS/2, preserving your investments in Word training and data.

With Microsoft Word 5.0 for UNIX Systems, you can share a single copy of Word — on a single PC — with an entire workgroup of 16, 32, or even more users on inexpensive terminals.

And your workgroup can share documents, style sheets, forms, macros, glossaries, and outlines — plus group review and editing features such as annotations and redlining — while sharing expensive printers and other resources as well.

Of course, Microsoft Word 5.0 for UNIX Systems still gives you Word's advanced productivity features. Data, text, and graphics integrated in a single document. Text flow around graphics. Side-by-side columns. A vast array of fonts and sizes. Links to spreadsheets and other programs. Line and box drawing. Spell checker and thesaurus. Speedkeys. And a whole lot more.

And since it's compatible with SCO Portfolio,™ Microsoft Word 5.0 for UNIX Systems supports the SCO Portfolio Clipboard, letting you copy and paste data to and from other popular applications such as SCO Professional and SCO FoxBASE+.

Call ext. 8605 at SCO today for the SCO Authorized Reseller nearest you. And see for yourself that if you want your SCO XENIX or UNIX System running the best multiuser word processing available today, you'll have our Word on it.

SCO®
THE SANTA CRUZ OPERATION

(800) SCO-UNIX (726-8649)
(408) 425-7222
FAX: (408) 458-4227
E-MAIL: . . . !uunet!sco!info
info@sco.COM

Circle 255 on Reader Service Card

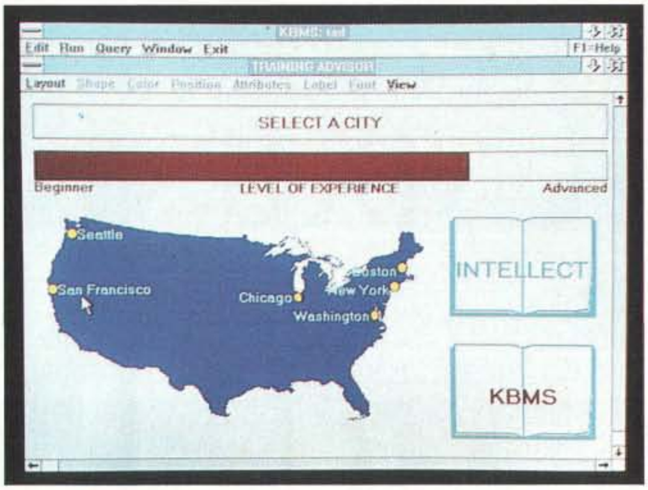
Active Objects and Graphics Added to KBMS for OS/2

Two tools included in AICorp's new version of its Knowledge Base Management System (KBMS) for the OS/2 Presentation Manager let developers use graphics during the application development process and incorporate graphics in the resulting application.

Developer Graphics, a tool for designing, developing, and analyzing KBMS applications, has a graphical editor facility that lets you select an object, see the attributes defined for that object, and view the relationships among objects during the development process, AICorp says.

Active Objects lets you link rules with graphics, building knowledge-base applications with a graphical user interface. For example, you can use Active Objects to develop a course registration application in which users see a map of the U.S., click on a city where they want to take a course, and automatically register and update the underlying database, instead of filling out forms or using a text menu.

The Active Objects editor lets you choose shapes, colors, fonts, and other elements. You can also use bit-mapped images from other sources.
Price: $7500.
Contact: AICorp, 100 Fifth Ave., Waltham, MA 02254, (617) 890-8400.
Inquiry 1143.



With AICorp's Active Objects, an expert system can display information graphically instead of relying on text only.

Better IPC for Unix, OS/2

XIPC (for Extended Interprocess Communications Facilities) is a software library designed to augment the interprocess communications facilities of Unix, OS/2, and VMS. In the area of software engineering, XIPC supports on-line monitoring of all IPC activities of a live system, multiple views of the same system, interactive debugging, and browsing of message queues and shared memory of an active system. It also lets you configure and use multiple instances of XIPC without modifying the operating-system kernel, Momentum says.

The package adds a message queue facility that offers atomic multiple-queue operations by multiple processes, individual queue slicing, automatic overflow spooling, and many other functions.

XIPC provides for automatic portability of source code among operating systems, while supporting a superset of the functionality of all supported operating systems.

The package will be available for OS/2, SCO Xenix, Unix System V, AIX, SunOS, Ultrix, and VAX/VMS.
Price: $1495 and up.
Contact: Momentum Software Corp., 602 Fair Lawn Pkwy., Saddle Brook, NJ 07662, (201) 794-1462.
Inquiry 1146.

Spelling Checker for Programmers

SpellCode, a customizable spelling checker for programmers, can check both the text that end users will see and the contents of program files. SpellCode checks variable and constant names, reducing the number of compiler or interpreter errors, says Geller Software.

SpellCode comes with an English dictionary and a dictionary of computer terms. The program knows the keywords used in dBASE languages and can check Ada, COBOL, PL/1, FORTRAN, and other languages. It can check the contents of character and memo fields in DBF data files or Lotus 1-2-3 worksheets.

SpellCode runs on the IBM PC with 256K bytes of RAM and DOS 2.0.
Price: $99.95.
Contact: Geller Software Laboratories, Inc., 35 Stephen St., Montclair, NJ 07042, (201) 746-7402.
Inquiry 1144.

CUA Compliance for DOS

With Layout/CUA for DOS, a software development tool that works with Interactive Images' Easel/DOS graphical development tools, you can create applications that automatically comply with IBM's Common User Access guidelines. With Layout/CUA, you can add action bars and scroll bars, pull-down menus, and secondary windows to your DOS application.

Layout/CUA for DOS runs as an application under the OS/2 Presentation Manager. Once you've defined how the application will look, Layout/CUA automatically generates the necessary DOS code.

To run the system, you need an IBM PC with at least 640K bytes of RAM.
Price: $1900; Easel/DOS Development System, $7500.
Contact: Interactive Images, Inc., 600 West Cummings Park, Woburn, MA 01801, (617) 938-8440.
Inquiry 1147.

FORTRAN Subroutines for the Mac

IMSL has released three FORTRAN libraries for the Macintosh that provide more than 800 subroutines for solving mathematical problems, analyzing statistics, and special functions.

Features of the libraries include standard calling sequences, sophisticated error handling, and automatic allocation of workspace.

The libraries require a Mac II or SE/30 running Language Systems' FORTRAN compiler 1.2.1 and System 6.0.3.
Price: $3250.
Contact: IMSL, 2500 ParkWest Tower One, 2500 CityWest Blvd., Houston, TX 77042, (800) 222-4675 or (713) 782-6060.
Inquiry 1145.

continued

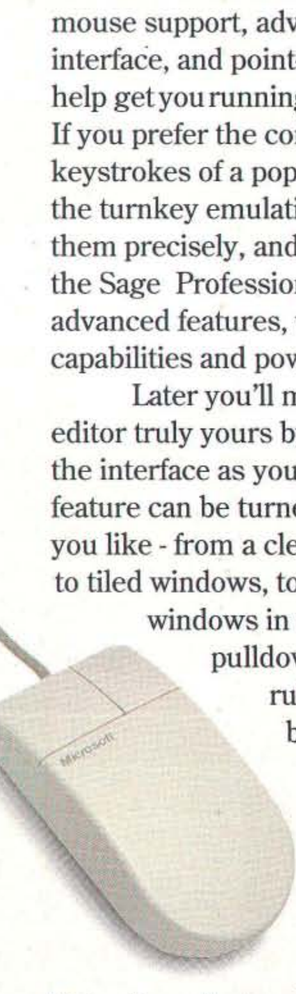
Sage Software
NEW, the next generation editor at Programmer's Paradise

Announcing the Sage Professional Editor - the editing environment for the 90's. The product of two years work by one of the most talented programming teams in the business. Right out of the box you'll be more productive with this editor than any you use today.

Announcing the Sage Professional Editor

The instant installation, elegant mouse support, advanced user interface, and point-and-shoot help get you running immediately. If you prefer the commands and keystrokes of a popular editor, the turnkey emulations duplicate them precisely, and you still gain the Sage Professional Editor's advanced features, windowing capabilities and powerful engine.

Later you'll make this editor truly yours by configuring the interface as you prefer. Every feature can be turned on or off as you like - from a clean screen, to tiled windows, to overlapping windows in various colors, pulldown menus, rulers, scroll bars, and line numbers - choose any or all and place them as you like.



Works with or without a mouse. Packaged with or without a Microsoft® Mouse.

Use the editor with or without a mouse - all functions are available without lifting your fingers from the keyboard.

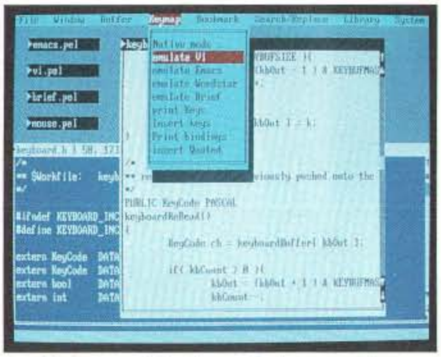
Pop open the DOS window and the editor shrinks to just 4K. So you can back-task to compilers and other tools without leaving the editor.

This package is stuffed with value. It includes MS-DOS, OS/2 and Dual Mode versions, templates for popular languages, and you can buy it with or without a bundled Microsoft® Mouse.

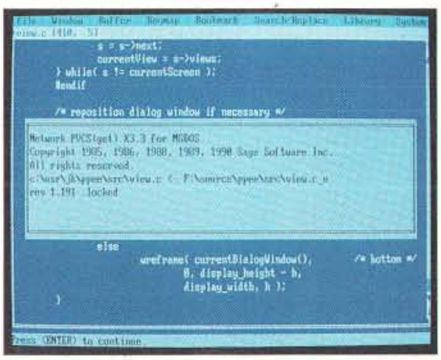
The core of the Sage Professional Editor is a powerhouse virtual memory system that allows you to edit huge files (up to 100MEG) in as many as 256 windows - over two billion lines. It makes maximum use of all available memory. All higher level services use this powerful VM scheme. Consequently, there are no size constraints on the macro library and no limit to Undo/Redo. You can have 1000 bookmarks, anchors and saved positions per buffer.

And then there's the extension language. The Sage Professional Editor uses a C-like extension language and compiler/ debugger that programmers find immediately intuitive. You can build the environment you want with the editor as the front end to your favorite tools. The seamless integration of the Polytron Version Control System (PVCS) is a sterling example of how cleanly you can hook external programs.

Emulations of Vi, Brief, EMACS, and WordStar, were written with the extension language. The source code for emualtion is included. Enter a new generation today by calling Programmer's Paradise.



Make our interface what you prefer, from clean screen to multi-window with drop-down menus and icons.



The editor environment provides seamless integration to the Polytron Version Control System (PVCS) or any other tool you care to connect.

	List	Ours
Single User Version	$295	$249
With a Microsoft Mouse	$395	$335

Both packages include: MS-DOS, OS/2 and Dual Mode versions on 3 1/2" and 5 1/4" disks.

1-800-445-7899

Programmer's Paradise

Circle 226 on Reader Service Card

Programmer's Paradise... for

WE'LL MATCH NATIONALLY ADVERTISED PRICES.

386 CONTROL PROGRAMS

	LIST	OURS
DESQview 386	190	169
Microsoft Windows/386	195	139
VM/386	245	199
VM/386 Multi-User	895	819

386 DEVELOPMENT TOOLS

	LIST	OURS
386 ASM/LINK	495	435
Lahey F77L-EM/32 (w/ OS/386)	1090	975
Novell C Network Compiler/386	995	779
Paradox/386	895	629
WATCOM C 7.0/386	895	799

ASSEMBLY LANGUAGE

	LIST	OURS
Advantage Disassembler	295	279
ASMFlow	99	89
ASMTool	90	80
MS Macro Assembler	150	105
OPTASM	125	109
Re:Source	150	129
Sourcer w/ Pre-Processor	140	125
Turbo Assembler/Debugger	150	105
Visible Computer: 80286	100	89

BASIC COMPILERS

	LIST	OURS
MS BASIC Prof. Devel. System	495	349
Power Basic	110	99
QuickBASIC	99	69
True BASIC	100	69

BASIC LIBS/UTILITIES

	LIST	OURS
db/LIB	139	121
DiaLogic	79	70
GraphPak	79	70
GraphPak Professional	149	125
LaserPak	79	70
P.D.Q.	99	89
ProBas	135	125
ProBas HyperHelp Toolkit	99	94
ProBas Telecomm. Toolkit	75	70
ProBas Toolkit	99	94
ProMath	99	94
ProScreen	99	89
QBase and Quickscreen	149	125
QuickComm	139	125
QuickMenu	59	55
QuickPak	79	70
QuickPak Professional	149	125
QuickPak Scientific	79	70
QuickScreen	79	70
QuickWindows Advanced	149	125
QuickWindows Advanced Corp.	500	445

C COMPILERS

	LIST	OURS
C Network Compiler	695	525
Lattice C 6.0	250	155
Microsoft C 6.0	CALL	CALL
MS Quick C	99	69
MS QuickC w/ QuickAssembler	199	139
Top Speed C	199	179
DOS Professional	399	359
OS/2 Professional	495	445
Turbo C	150	99
Turbo C Professional	250	159
WATCOM C 7.0	395	319

C++

	LIST	OURS
Guidelines C++	295	269
NDP C++	495	479
Zortech C++ Debugger	150	129
Zortech C++	200	165
Developer's Edition	450	399
Zortech C++ Tools	150	129
Zortech C++ Video Course	500	449

C-COMMUNICATIONS

	LIST	OURS
Breakout II	125	99
C Asynch Manager 3.0	189	139
Essential Communications	329	259
Greenleaf Comm. Library	299	215
Greenleaf ViewComm	559	475
SilverComm C Async Library	249	209
View-232	189	149

C-FILE MANAGEMENT

	LIST	OURS
Btrieve	245	185
Btrieve for DOS 3.1 Networks	595	449
C-Index Plus	195	175
C-ISAM	225	209
Codebase IV	295	219
CQL w/ PASS	395	349
c-tree	395	315
dBC III	250	219
dBC III Plus	500	439
db_FILE Bundle	295	249
Essential B-Tree w/ source	199	149
FairCom Toolbox - Prof. Edition	1095	789
FairCom Toolbox - Special	695	509
Informix Products	CALL	CALL
Xtrieve PLUS	595	459

C-GENERAL LIBRARIES

	LIST	OURS
C TOOLS PLUS/6.0	149	109
C Utility Library	249	175
Greenleaf Functions	229	159
Greenleaf SuperFunctions	299	209
Power Search	149	99
Turbo C TOOLS/2.0	149	109

C SCREENS

	LIST	OURS
C-Worthy w/ forms and source	495	CALL
Greenleaf DataWindows	395	309
Hi-Screen XL	149	129
JAM	595	529
Panel Plus	495	395
Power Screen	149	109
Vermont Views	CALL	CALL
Vitamin C	225	165
VC Screen	149	115

C-UTILITIES/OTHER

	LIST	OURS
Clear +	200	169
C-Terp	300	219
Code Runner	149	135
Heap Expander	80	70
HyperWindows	99	90
Norton Guides for C	100	65
PC-lint	139	109
PCYACC Professional	495	469
TimeSlicer	295	279
w/ source	1000	899

COBOL LANGUAGE

	LIST	OURS
Micro Focus:		
COBOL/2 w/ Toolset	1800	1499
Personal COBOL	149	129
MS COBOL	900	629
Realia COBOL	995	849
SCREENIO	400	375

CODE GENERATORS

	LIST	OURS
C Source	395	299
Logic Gem	99	89
Matrix Layout 2.0	200	169
PRO-C	399	339

DATABASE DEVELOPMENT

	LIST	OURS
Clarion 2.0	695	499
Clipper 5.0	695	519
dBASE IV	795	489
dBFast/PLUS	249	219
dGE	195	179
FlashTools!	89	79
FoxPro	795	635
Magic PC	299	249
R&R Report Writer	150	129
R&R Code Generator	150	129
Say What?!	50	45
SilverComm Library 2.0	189	165
Tom Rettig's Library	100	80
UI2 Version Two	595	479

DOCUMENTING/ FLOWCHARTING

	LIST	OURS
Clear+	200	169
C-Clearly	130	115
Flow Charting II+	229	185
Interactive Easyflow	150	125
Paginate	100	90
Source Print	99	89
The Documentor	295	245
Tree Diagrammer	99	89

EDITORS

	LIST	OURS
BRIEF 3.0	199	CALL
Edix	195	165
EMACS	325	265
Epsilon	195	138
KEDIT 4.0	150	125
MKS Vi	149	129
Multi-Edit	99	89
Multi-Edit Professional	179	159
Norton Editor	75	59
SLICK Editor	195	175
SPF/PC	245	199
VEDIT PLUS	185	115
Vq^2	150	135

FORTRAN LANGUAGE

	LIST	OURS
Grafmatic	135	119
Lahey F77L	595	529
Lahey Personal FORTRAN 77	95	89
MS FORTRAN	450	299
Plotmatic	135	119
RM/FORTRAN	595	499

GRAPHICS LIBRARIES

	LIST	OURS
Baby Driver	250	199
Essential Graphics	399	279
Font-Tools	150	119
Font Window	125	109
GraphiC 5.0	395	319
Graphics-MENU	195	175
Data Entry Design	99	89
Data Entry Module	59	53
GSS Graphics Devel. Toolkit	595	509
HALO	395	279
HALO Window Toolkit	595	419
Icon-Tools/Plus	150	119
Menuet	250	199
MetaWindow	250	209
MetaWindow Plus	325	269
PCX Effects	99	89
PCX Programmer's Toolkit	195	175
PCX Text	149	135
Turbo Geometry Library	200	179

LINKERS/LIBRARIANS

	LIST	OURS
Plink86plus	495	395
PolyLibrarian II	149	135
.RTLink	295	265
.RTLink/Plus	495	419

MODULA-2

	LIST	OURS
LOGITECH Modula-2:		
Compiler Pack	99	75
Development System	249	199
TopSpeed Modula-2:		
B-Tree Toolkit	149	135
Communications Toolkit	149	135
Compiler Kit	100	89
DOS 3-Pack	200	179

NETWORK PROGRAMMING

	LIST	OURS
Above LAN	495	395
Btrieve/N	595	459
Novell C Network Compiler	695	559
dBASE IV LAN Pack	995	645
FoxBASE +/ LAN	595	479
NetWare SQL	595	459
Paradox LAN Pack	995	697
Remote Procedure Calls	950	829

OS/2 TOOLS

	LIST	OURS
Brief	199	155
Btrieve	595	449
CASE:PM	CALL	CALL
Epsilon	195	159
Greenleaf DataWindows	395	330
MKS LEX:YACC (OS/2)	399	339
MKS Toolkit (DOS & OS/2)	399	339
MS OS/2 Pres. Mgr. Softset	150	105
MS OS/2 Pres. Mgr. Toolkit	500	349
MultiScope	299	229
Panel Plus	495	395
PC-lint	139	101
PCYACC	395	359
Smalltalk/V PM	495	395
Vitamin C (OS/2)	225	165
XVT/PM	595	509

PASCAL LANGUAGE

	LIST	OURS
Asynch PLUS	149	115
B-tree Filer	125	99
MS QuickPASCAL	99	69
Object Professional	150	119
Power Tools PLUS/5.0	149	109
Topaz	75	67
Turbo Analyst	99	79
TurboMAGIC	199	179
Turbo Pascal 5.5	150	99
Turbo Pascal 5.5 Professional	250	169
Turbo-Plus 5.5	199	159
Turbo Professional 5.0	125	99

PROTOTYPING

	LIST	OURS
Dan Bricklin's Demo II	195	159
Instant Replay III	150	135
ProtoFinish	300	269
Show Partner F/X	350	319
Soft Demo	80	70

TRANSLATORS

	LIST	OURS
Bas_C Commercial	375	323
dBx Translator	550	467
FOR_C	575	519
PROMULA.FORTRAN	450	399

WINDOWS (MS) TOOLS

	LIST	OURS
Actor 2.0	699	559
Case:W	795	759
C-Talk/Views	450	375
dBFast/Windows	249	229
DialogCoder	499	479
MS Windows Development Kit	500	349
RFFlow	79	69
Whitewater Resource Toolkit	195	169
WinTrieve	395	339

ADDITIONAL LANGUAGES

	LIST	OURS
APL*PLUS	695	549
Janus Ada/Compiler System	300	269
Lattice RPG	1600	1469
Meridian AdaStudent	50	45
Meridian Ada Developer's Kit	1095	985
MKS AWK	99	85
Personal Rexx	150	139
Smalltalk-80 (386)	595	535
Smalltalk/V	100	85
Smalltalk/V 286	200	169

NEW RELEASES

SECOM *by Secure Communication Technologies*
SECOM is a secured encryption communications solution for PC's. SECOM supports IBM and IBM compatibles and gives you the ability to securely exchange mail, files and fax's while communicating bidirectionally. SECOM is DES approved and includes an Auto Session Key System.

List: $300 **Ours: $269**

Norton Backup *by Peter Norton Computing*
Speedy, reliable and easy to use. Reads the hard disk and writes to a floppy simultaneously. Norton Backup can restore from severely damaged disks. Saving and restoring can be done quickly by pointing and shooting through organized pop-up windows.

List: $149 **Ours: $99**

Actor 2.0 *by The Whitewater Group*
Create windows applications in significantly less time than it takes in C. Actor 2.0 adds three new features: ancestor binding, class variables and class initialization.

List: $699 **Ours: $559**

Service, Selection, $avings (800) 445-7899

Borland Spring Sale

	List	Ours
Paradox	725	479
Sidekick Plus	200	139
Turbo Assembler/Debugger	150	99
Turbo C 2.0	150	99
Turbo C Professional	250	159
Turbo Debugger & Tools	CALL	CALL
Turbo Pascal 5.5	150	99
Turbo Pascal Professional	250	169

APPLICATION SOFTWARE

	LIST	OURS
COMMUNICATIONS		
BLAST	250	225
Carbon Copy Plus	199	129
DeskLink	170	129
Laplink III	150	99
PC Anywhere III	145	99
Procomm Plus	75	50
SideTalk	120	90
DESKTOP PUBLISHING		
Adobe Illustrator	695	409
Corel Draw!	595	399
Gem Desktop Publisher	299	183
HALO DPE	195	139
Lattice HighStyle	375	319
MKS SQPS	495	479
PageMaker	795	509
Ventura Publisher	895	525
MATHEMATICS		
Derive	200	179
MathCAD	495	315
Mathematica 386	695	625
SCIENCE & ENGINEERING		
AutoCAD Release 10	3000	CALL
AutoSketch	150	95
ChiWriter	150	129
Control System Toolbox	495	375
CSS	495	469
DADiSP	895	759
Design CAD 3-D	400	292
Drafix Windows CAD	695	CALL
EXACT	475	380
Generic CADD Level 3	300	179
LABTECH Acquire	195	179
LABTECH Chrom	995	779
LABTECH Notebook	995	779
MICRO-CAP III	1495	1269
Orcad PCB	1495	CALL
PC TEX	249	229
SCHEMA II+	495	449
STATGRAPHICS	895	586
Tango CAD Pack	995	949
Tango PCB Series II	595	559
TECH*GRAPH*PAD	395	319
T^3	595	479
UTILITIES		
386 MAX	75	66
386 MAX Professional	129	115
above DISC	119	84
Command Plus	130	109
FASTBACK Plus	189	109
HeadRoom 2.0	130	109
Help Build	249	179
MACE GOLD	149	129
Magellan	139	99
Manifest 1.0	60	53
Memory Mate	70	47
MKS Toolkit	249	199
Move'em	89	79
Norton Commander	89	58
Norton Utilities	100	65
Norton Utilities Advanced	150	99
PC/Tools Deluxe	129	80
Pizazz Plus	149	79
QEMM/386	60	55
QRAM	80	69
SpinRite	89	69
XTreePro	129	109

PRODUCTS BY VENDOR

	LIST	OURS
DIGITALK		
Smalltalk/V	100	85
Communications	50	45
EGA/VGA Color Extension	50	45
Goodies #1, #2 or #3	50	45
Smalltalk/V 286	200	169
Smalltalk/V MAC	200	159
Smalltalk/V PM	495	395
IGC		
VM/386	245	199
VM/386 Multi-User	895	819
VM/386 Multi-User Starter	395	359
VM/386 NetPak	150	119
MICROSOFT		
MS BASIC Prof. Devel. System	495	349
MS C	495	349
MS COBOL	900	629
MS FORTRAN	450	299
MS Macro Assembler	150	105
MS OS/2 Present. Mgr. Toolkit	500	349
MS OS/2 Softset	150	105
MS Pascal	300	209
MS Programmer's Library	395	275
MS QuickBASIC 4.5	99	69
MS QuickC 2.0	99	69
MS QuickC w/ QuickAssembler	199	139
MS QuickPASCAL	99	69
MS Windows	99	69
MS Windows/386	195	139
MS Windows Development Kit	500	349
MS Word for Windows	495	349
MORTICE KERN SYSTEMS		
MKS AWK	99	79
MKS LEX:YACC	249	197
MKS MAKE	149	119
MKS Programming Platform	665	599
MKS RCS	189	149
MKS Software Mgmt. Team	299	239
MKS SQPS	495	479
MKS Toolkit	249	197
MKS Trilogy	119	105
MKS Vi	149	125
POCKET SOFT		
.RTLink	295	265
.RTLink PLUS	495	419
SAGE SOFTWARE/POLYTRON		
C Beautifier	50	42
Dan Bricklin's Demo II Program	199	159
PFinish	295	259
PFix86Plus	295	259
Plink86plus	495	395
PolyAWK	99	85
OS/2 Version	199	179
PolyBoost II	80	72
PolyDoc	199	169
PolyLibrarian	99	85
PolyLibrarian II	149	125
PolyMake 3.0	149	125
PolyShell	99	85
PolyXRef	99	85
Professional PVCS (Corporate)	495	419
w/ PolyMake for OS/2	695	589
PVCS/MAKE for OS/2	395	335
ZORTECH		
Zortech C Video Course	300	269
Zortech C++ Compiler V2.0	200	165
w/ source	300	259
Zortech C++ Debugger V2.0	150	129
Zortech C++ Developer's Edition	450	399
Zortech C++ Tools V2.0	150	129
Zortech C++ Video Course	500	449

Programmer's Policies

Phone Orders
Hours 9 AM-7 PM EST. We accept MasterCard, Visa, American Express. Include $4.00 per item for shipping and handling. All domestic shipments by UPS ground. Rush service available.

Mail Orders
POs by mail or fax are welcome. Please include phone number.

International Service
Phone number required with order. Call or fax for additional information.

Dealers and Corporate Accounts
Call for information.

Unbeatable Prices
We'll match nationally advertised prices. (Subject to same terms and conditions.)

Return Policy
30-day no-hassle return policy. Most manufacturer's products cannot be returned once disk seals are broken.

HELP/BUILD

An Automated Documentation System

HELP/BUILD is a complete help information and error screen generation tool. It allows you to develop any kind of pop-up help and error message system. You can create independent help systems which users call at the touch of a hot-key. You can link the help screens in any order to lead your users to the next information they should see. HELP/BUILD is menu driven and includes its own screen editor, optimizer, compiler, cross-reference generator and run module. Builds context sensitive help. Requires hard disk and 256K memory.

PACIFIC FIRMWARE MARKETING CORP.

List: $249
Ours: $179

.RTLink/Plus

The only MS-DOS linker with CodeView support for multiple/nested overlays. Advanced technology allows more overlays, overlay areas, symbols, objects, classes, and sections than any other linker. Smart caching of most recently accessed overlay sections in conventional, expanded, and extended memory (new XMS specifications). Easy-to-use Profiler provides detailed performance statistics without source code modification. Run-Time Libraries (RTLs) speed development time and reduce disk space/modem-time requirements. Source code provided for overlay manager and Profiler's read-analysis utility. LIBLIST provides detailed information on inter-relationships between modules—great for optimizing and designing overlay schemes.

List: $495 *Ours: $419*

Pocket Soft Inc.

VM/386 & VM/386 NetPak

If you've ever had to wait for your computer to finish processing a task, you need VM/386. It lets you create lots of DOS sessions on your 386 PC, each running a different application on a full screen. All background sessions will continue to process whether you work in an application on your computer or go off to lunch. And with the addition of NetPak, each DOS session can interact with network files and peripherals. This is the only way you can multitask large programs without having to exit and re-enter the network.

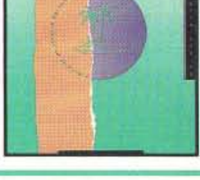
IGC

Make VM/386 & NetPak your choices for bullet-proof multitasking and easy network access.

VM/386: $199
VM/386 NetPak: $119
Together: $299

The new *Programmer's Paradise®* catalogs have arrived!!

Call today for your FREE copy.



International: **201-389-9228**
Customer Service: **201-389-9229**
Fax: **201-389-9227**

New Corporate Phone #:
800-422-6507

Call or Write for Latest Free Catalog!

1-800-445-7899

Programmer's Paradise®

A Division of Voyager Software Corp
1163 Shrewsbury Ave., Shrewsbury, NJ 07702

SOFTWARE • BUSINESS

Accounting with Database Orientation

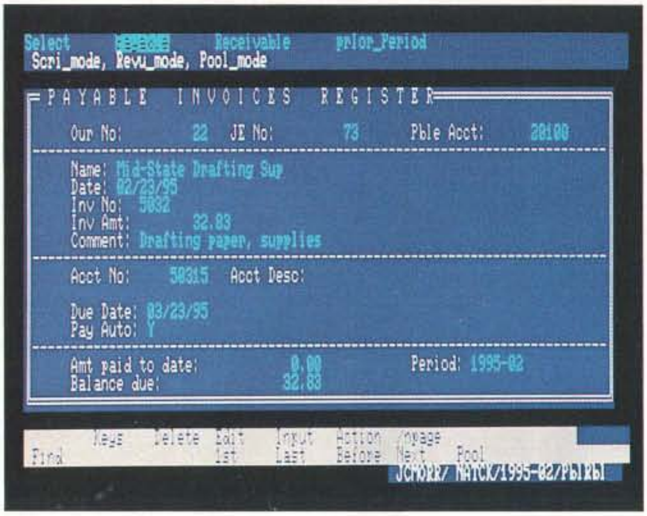
A low-end accounting program called AXS (pronounced "access") Accounting Solutions features a database orientation that lets you work with accounting data interactively. The program's database structure lets you enter, edit, scroll, find, select, and take action on a data file, all from the same form, Computer Trends says.

When you write a check or make a deposit, you can use the payee, vendor, or customer name. If you're not sure of the exact name, you can enter the first few letters and scroll through the companies in the database that match.

AXS updates reports as you enter transactions without requiring batching. The real-time system updates accounts instantly, so you can generate period-to-date financial statements at any time. You can also prepare activity reports (e.g., income statements, profit and loss statements, and balance sheets).

AXS Level 2 includes general ledger, accounts payable, accounts receivable, a check writer, and a mail manager. AXS Level 1 includes only general ledger (with a check-writing facility). AXS Accounting Solutions Level 2 version 2.0, scheduled for release this summer, will include payroll, inventory, job costing, and time billing modules. New features will include budgeting, comparative financial statements, exporting, and recurring transactions.

Price: Level 1, $59.95; Level 2, $139.95.
Contact: Computer Trends, 116 East Washington St., Ann Arbor, MI 48104, (800) 544-2597 or (313) 662-4430.
Inquiry 1148.



The AXS Accounting Solutions' database structure lets you perform a number of operations on a data file from the same form.

Four Accounting Modules for the Mac

Pro Plus Accounting consists of four modules that you can use as stand-alone programs or link to form an integrated system. The system features multiple-level password protection and can export reports in ASCII text, SYLK, and Excel format, its developer reports. The four modules are general ledger, accounts receivable, accounts payable, and inventory control.

To run the program, you need a Mac II or higher with a hard disk drive.

Price: $995; each module, $350.
Contact: Pro Plus Software, Inc., 2150 East Brown Rd., Mesa, AZ 85203, (602) 461-3296.
Inquiry 1149.

Forms Software Does More Than Create Blanks

In addition to its ability to create fill-in-the-blank forms, a forms completion and management program called Blankity Blank works with your word processor's mail-merge capabilities to create hundreds of forms and documents from databases and questionnaires. When used with the separate Blankity Blank DB-Link, you can import information needed to complete forms from up to five other external databases created by Blankity Blank or another DBMS.

The latest version, 3.0, features point-and-shoot screens, multiple simultaneous document and form completion, and one-pass laser printing, where a form and its associated data are printed at the same time.

Blankity Blank's math capabilities let you do addition, subtraction, rounding, and other basic mathematical operations automatically in a form. It can also convert the numeric form of a number to text.

The program runs on the IBM PC with 640K bytes of RAM.

Price: $99.50; four-user network version, $249.50; DB-Link, $199.50 and $449.50, respectively.
Contact: Softstream Technologies, Inc., 2740 Hollywood Blvd., Hollywood, FL 33020, (800) 888-9292 or (305) 920-9292.
Inquiry 1151.

continued

Streamline Organizational Writing with One Voice

Scandinavian PC Systems, publisher of the style-checking program Readability Plus, has released a new program that lets businesses create their own style models. An organization can thus establish and enforce writing standards based on its own best-written products. With Corporate Voice, you identify your company's stellar proposals, briefs, reports, and other documents; the program then uses these documents to create corporate style models that help staff writers replicate outstanding written products.

Corporate Voice uses the style models to evaluate similar documents. It identifies inappropriate sentences and determines the percentage of sentences that fit the selected style model. In addition, the program guides the writer through the revision process, after which the document will closely resemble its original style model.

Corporate Voice works directly with WordPerfect (including version 5.1), Microsoft Word, and WordStar. It can also read ASCII files. The program requires 256K bytes of RAM and will run on any DOS 3.0–compatible LAN.

Price: $119.95.
Contact: Scandinavian PC Systems, Inc., 51 Monroe St., Suite 1101, Rockville, MD 20850, (800) 288-7226 or (301) 294-7450.
Inquiry 1150.

Engineering Database for the Earth Sciences

Techbase, a relational DBMS for earth science engineering projects, combines graphics, modeling, and statistics with the ability to handle the large numeric data sets often encountered in mining, petroleum, and similar industries.

You can add or delete database fields at any time; files and tables within a database can vary in size; and you can store data in flat, polygon, cell, layer, or block format.

All Techbase modules have filtering capability to selectively retrieve data or regroup it in subsets for further analysis and graphing. The program can calculate common statistics such as mean and standard deviation, plus chi-squared and two-tailed t-distribution hypothesis statistics. It can also calculate correlation coefficients.

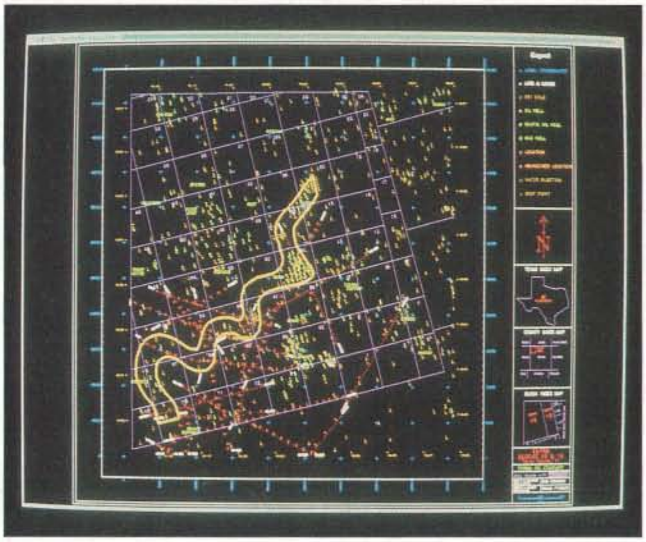
Techbase can generate four kinds of statistical plots: cumulative frequency plots, scatter plots, histograms, and ternary diagrams. You can annotate the graphs with text, lines, and graphics. Graphics capabilities include contouring, cross sections, digitizing, plotting, three-dimensional perspective, and vector. You can include up to 128 customized markers on a graph or plot.

Techbase runs on PCs and workstations from IBM, Sun, DEC, Hewlett-Packard, Silicon Graphics, and others. It requires a minimum of 640K bytes of RAM and a hard disk drive.

Price: Single-user, $2840 and up; multiuser, $5190 and up.

Contact: MINEsoft Ltd., 1801 Broadway, Suite 910, Denver, CO 80202, (303) 292-6449.

Inquiry 1160.



A map of blocks 19 and 18 in Taylor County, Texas, made with Techbase. In addition to the legend on the right, the base map includes state index, county index, and block index maps.

Data Acquisition with Graphing, OOP Language

LabOBJX combines data acquisition with math, statistics, and graphing. According to Scientific Software Tools, LabOBJX's programming language combines the object-oriented capabilities of Smalltalk with syntax similar to that of Pascal and Modula-2, letting you modify routines to fit your requirements in the laboratory.

The compiler, linker, editor, analysis, and interface tools are integrated in the run-time application environment, and at any time during execution you can create and integrate new commands or displays of data.

The program lets users work from the command line (for advanced lab personnel) or with pull-down menus (for novices). LabOBJX supports three-dimensional axonometric and mesh plots and several other types of graphs, including real-time display of signal traces.

To run LabOBJX, you need an IBM PC with 640K bytes of RAM; a math coprocessor is recommended.

Price: $1995.

Contact: Scientific Software Tools, Inc., Penn State Technology Development Center, 30 East Swedesford Rd., Malvern, PA 19355, (215) 889-1354.

Inquiry 1161.

Nonlinear Curve Fitting Added to Plotting Program

SigmaPlot 4.0, a scientific graphing program, lets you define almost any equation, or sets of equations, with up to 25 parameters and 10 independent variables, and fit the equation to your own data. In addition to the nonlinear curve-fitting capability, the company has added a pull-down menu interface and more graph types and has increased the program's worksheet capabilities.

Jandel Scientific says that it has expanded the SigmaPlot worksheet to 16,000 columns by 65,000 rows. The program directly supports Lotus spreadsheet files, including named ranges. It also supports DIF files and ASCII.

SigmaPlot 4.0 runs on the IBM PC with 640K bytes of RAM and a hard disk drive.

Price: $495.

Contact: Jandel Scientific, 65 Koch Rd., Corte Madera, CA 94925, (800) 874-1888 or (415) 924-8640.

Inquiry 1164.

Electromagnetic Analysis Added to FEA Program

A new version of Cosmos/M, a finite-element analysis system for IBM PCs, Mac IIs, and Unix workstations, includes a module for performing FEA of electromagnetic problems. Called Estar, the new module features nonlinear analysis and includes B-H material and permanent magnet demagnetization curves, its developer reports. (A B-H material curve refers to the magnetic flux density [B] versus magnetic field intensity [H] curve that's used to solve nonlinear material curve design problems.) The module can handle force calculations on ferromagnetic objects under externally applied fields and supports two- and three-dimensional magnetostatic modeling while including the current effects for the 2-D and axisymmetric cases under study.

In all, the program has 11 modules, including fluid, nonlinear static, heat transfer, linear dynamic, and linear static analysis. Cosmos/M 1.60 can solve problems of up to 15,000 nodes and 60,000 degrees of freedom. It requires a hard disk drive with at least 10 MB.

Price: $995 and up.

Contact: Structural Research and Analysis Corp., 1661 Lincoln Blvd., Suite 200, Santa Monica, CA 90404, (213) 452-2158.

Inquiry 1163.

continued

Open Server. Closed Server.

Runs on every vendor's operating system: OS/2,™ VINES,® UNIX,™ VAX® VMS, IBM® MVS, etc.	Runs only on OS/2.
Supports every vendor's local area network protocol: Novell's® SPX/IPX,™ NetBIOS, Named Pipes,™ etc.	Supports only Named Pipes.
Transparent access to data in other vendor's databases: IBM's DB2™ and SQL/DS, and Digital's RMS.	Does not provide access to any other database.
Transparent data sharing between all your computers: PCs, minis and mainframes.	Can't even transparently share data between two PCs running Ashton-Tate SQL Server.
Lotus 1-2-3® spreadsheets and dBASE® applications work with ORACLE Server today.	Doesn't work with either Lotus 1-2-3 or dBASE just yet.
Developers have a complete and integrated family of portable tools for CASE, applications generation, report writing, etc.	Supports only Focus.
Programmers can use interfaces from C, COBOL, and FORTRAN.	Supports only C.
Certified by Codd and Date to run at 11.0 TP1 transactions per second.	Ashton-Tate SQL Server's published benchmarks show it to be slower.

Oracle Client/Server Forums
1990 Schedule

Tuesday, April 3	Boston
Thursday, April 5	Philadelphia
Tuesday, April 10	Cincinnati
Thursday, April 12	Toronto
Tuesday, April 17	Newport Beach
Thursday, April 19	San Francisco

Call to register for the Oracle Client/Server Forum nearest you. Or order ORACLE Server for OS/2 for only \$2499 and get six months of phone support and upgrades for free (a \$500 value). Or try our Developer's Version (limited to 3 users) for only \$699.

ORACLE®

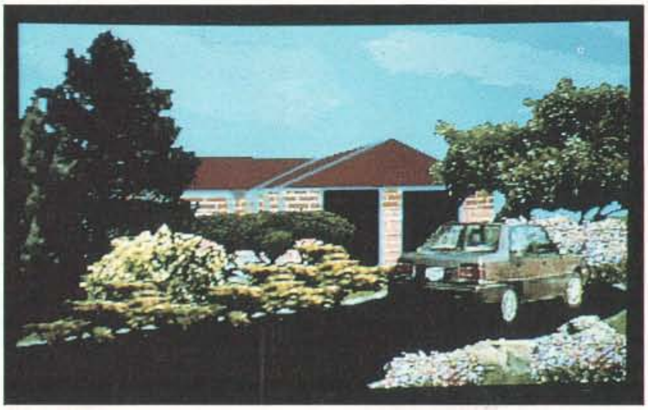
Call 1-800-ORACLE1, ext. 4965. We're always open.

Animate Building Sites with VideoScapes

A video library for land planning professionals that works with Autodesk's Animator lets you take an image of a planned building site that's bereft of buildings, trees, people, and cars and create a full-color, animated presentation that shows how the proposed site will look upon completion.

Called VideoScapes, the library encompasses hundreds of images, including people, trees, plants, cars, and other objects, that you can size to fit a CAD drawing or insert into an Animator video image. VideoScapes includes building-face patterns such as brick, cedar, and other textures.

Using the animation capabilities of Animator, VideoScapes' cars can move across the screen, trees can grow, and people can walk through the site. With a video capture board, you can import a video of the proposed site, render a three-dimensional CAD drawing of the building with Animator and VideoScapes, and combine those separate elements into an animated presentation for a client.



With the VideoScapes library and Animator, cars can move, trees can grow, and people can walk through a building site.

VideoScapes comes in Animator and Targa formats.
Price: $495.
Contact: LandCADD, Inc., 7519 East Highway 86, Franktown, CO 80116, (303) 688-8160.
Inquiry 1152.

Access COGO Reference Points Through Database

The AutoCAD release 10 add-in E.S. (for expert system) COGO lets you access COGO reference points through an external database instead of having to select the point on-screen. According to Applications Publishing, this feature is useful for engineers who need the hidden data and attributes of many reference points in a large drawing. You can use more than 100 commands while working on the external database to retrieve information such as the distance between two reference points.

A new Universal Data Collector converts raw field data into a representative drawing, and the Master Symbol Library performs symbol insertion for each COGO reference point that you've entered via a description code.

E.S. COGO and E.S. COGO Contour (for contour mapping, plan and profile modeling, and other representations of data) each require extended AutoLisp and AutoCAD running on an IBM AT with 640K bytes of RAM and a hard disk drive.
Price: $2500; E.S. COGO Contour, $1000.
Contact: Applications Publishing, Inc., One Harbor Dr., Suite 103, Sausalito, CA 94965, (415) 332-1111.
Inquiry 1159.

Autodesk Ships PM Version of AutoCAD

Autodesk's version of AutoCAD release 10 for OS/2 Presentation Manager (PM) is the latest in the company's introductions of AutoCAD for high-end platforms, including one for Unix (specifically, the SCO Xenix and SCO Unix System V/386 operating systems), and a DOS-extended, 386-specific version.

Autodesk says that the multitasking capabilities of OS/2 make it a natural platform for AutoCAD. As is the case with other DOS programs ported to OS/2, many new features of AutoCAD for OS/2 are OS/2 features, such as multitasking, the PM graphical user interface, and Dynamic Data Exchange. Another feature is the ability to port AutoCAD files for OS/2 to any other platform running AutoCAD release 10, without file conversion. (However, this is a standard feature of all versions of AutoCAD release 10.)

AutoCAD for OS/2 requires at least 4 MB of memory and an 80287 or 80387 coprocessor. It is compatible with either the Standard or Extended Edition of OS/2.
Price: AutoCAD for OS/2 and Unix, $3000; for extended DOS, $3300.
Contact: Autodesk, Inc., 2320 Marinship Way, Sausalito, CA 94965, (415) 332-2344.
Inquiry 1153.

Ad Hoc Reporting, New Attributes Added to EASIMAP

EASIMAP (Equipment and Systems Installation Management and Planning) 3.0, a data-center facility-planning add-in for AutoCAD, features true ad hoc reporting capabilities and more than 60 new attributes per symbol. New attributes include leasing and maintenance, square footage of each machine, airflow in cubic feet per minute, operating temperature and relative humidity tolerances for each machine, and more.

With the ad hoc capabilities, you can sort up to three attributes and search up to four attributes concurrently. Some of the other EASIMAP attributes include British Thermal Units to air and water, weight, machine type, and serial number.

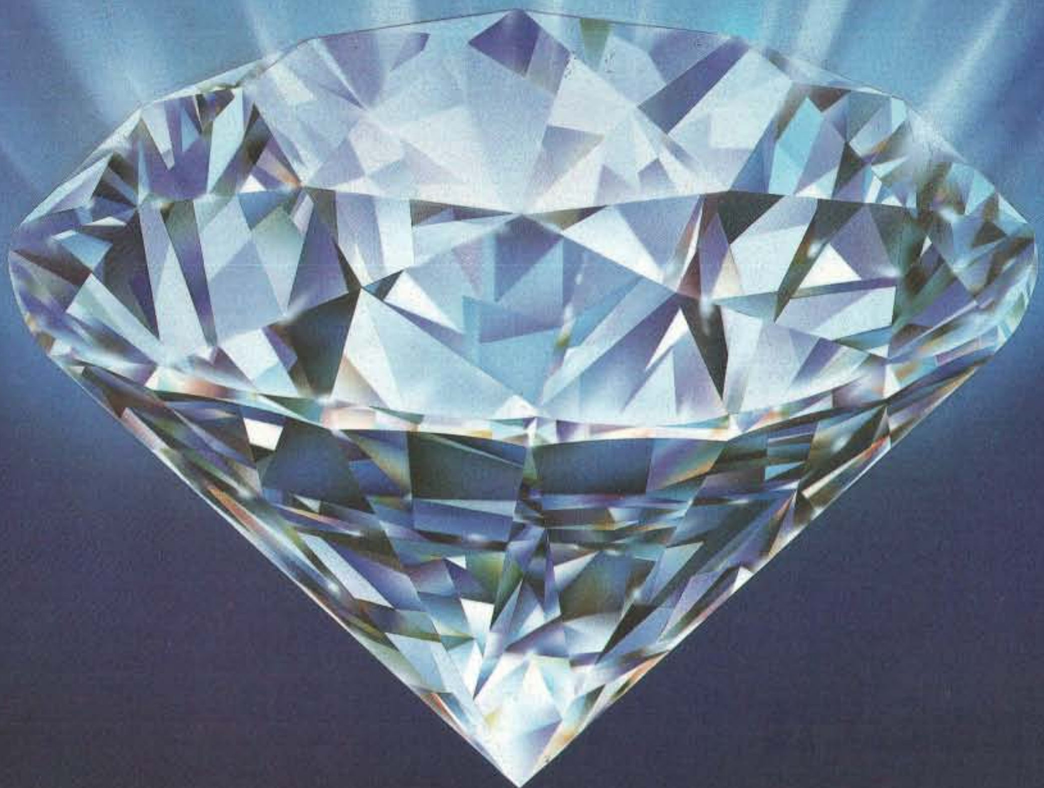
EASIMAP comes standard with three-dimensional symbol libraries for IBM, multi-layered/multicolored symbol libraries, and a DXF file translator. Additional symbol libraries are available for DEC, Cray, and other systems.

EASIMAP runs on the IBM AT, Mac II, and Sun and Apollo systems with AutoCAD release 9 or higher, a math coprocessor, and a hard disk drive with 3 MB of available space.
Price: $2750 and up; additional libraries, $275 each.
Contact: 21st Century Innovations, Inc., 23861 El Toro Rd., Suite 611, El Toro, CA 92630, (800) 327-4627 or (714) 768-8060.
Inquiry 1158.

EUROPE AND WORLD

ILLUSTRATION: SANDRA FILIPPUCCI © 1990

Gem Of A Design



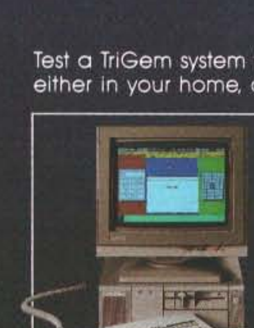
MODULAR DESIGN CONCEPT

The Modular Design Concept of TriGem computer systems is unique in that they do not use "mother boards". Instead, ISA standard bus slots provide the added advantage of allowing a single logic board containing all the computing power of a CPU, DMA, RAM, serial and parallel I/O, RTC and FDC to be placed anywhere on the bus, regardless of the slot location.

FLEXIBILITY AND EXPANDABILITY

The Modular Design Concept means maximum expandability at minimal expansion investment; so your TRIGEM COMPUTER SYSTEM grows as your business grows. TriGem's systems provide you with a continuous upgrade path from low-end XTs to powerful 386 systems, by swapping boards into one of the I/O slots. In addition, our modular design allows the field engineer to perform easy after-sale service.

Test a TriGem system today in your specific application; either in your home, office or in an industrial environment.



TriGem 286S

SPECIFICATION: · 6/12MHz switchable 80286 microprocessor · IMB memory with parity expandable upto 4 MB on board · Real-time clock/calendar with life-time battery back-up · One serial port/one parallel port · Built-in FDC · Five 8/16-bit slots · Size: 340mm(W)×380mm(L)×110mm(H)

TriGem

TriGem Computer (Europa) GmbH, Hauptstrasse 350, 6236 Eschborn, W. Germany Tel.: 49-6173-64 00 66 Fax.: 49-6173-61 703

Authorized Distributors

Circle 326 on Reader Service Card

Swiss A Siegrist SIEBO AG Tel.: 031-91 25 25 Bowil **Netherlands** Add On BV. Tel.: 049 02-4 11 65 Valkenswaard **Denmark** Beta Computer Systems A/S Tel.: 06-82 61 00 Silkeborg **Sweden** Glasdon AB Tel.: 0 31-44 94 60 Partille **Norway** GS Norge Tel: 06-81 48 06 Strommen **Finland** Asea Skandia Tel.: 358-0-59 121 ESPOO **United Kingdom** Prism Computer, Ltd. Tel.: 0753-58 01 87 Fax.: 0753-58 02 21, LONDON

Virtual Channels:

The Next Generation of Transputers

Dick Pountain

The new Inmos H1 transputer will bring portable parallel programs much closer to reality

In several recent articles, I've discussed aspects of parallel computing using the Inmos transputer family of microprocessors. You can find a full description of the T800, the most advanced of the transputer family, in "T800 and Counting," November 1988 BYTE. More recently, I have described the Occam programming language and two different approaches to the problem of mapping parallel algorithms onto fixed networks of transputer processors.

To recap briefly, the transputer contains a complete CPU, a hardware task-scheduler, local memory, and four serial communications links on a single chip, a combination that allows it to be used to implement the Communicating Sequential Processes model of parallel computing. CSP considers a parallel program to be equivalent to a number of ordinary sequential programs running concurrently while exchanging messages over synchronous message channels.

The trouble is, current transputer hardware and software only partially embody the CSP model. A program running on a single transputer, faking parallelism by time slicing, can contain as many processes and message channels as memory permits, which for most practical purposes is unlimited. As soon as you want to distribute the processes onto different transputers for real parallelism, though, you find you are limited because the chip has only four communications links. This constraint severely cramps the way you can write programs and results in the loss of some of the advantages of the CSP model.

To reduce the number of channels used, you might have to (1) rewrite your single-processor program or (2) force the processes to share the scarce physical links by multiplexing many messages onto the same channel. The first approach defeats one of the main design objectives of Occam—avoiding the rewriting of its so-called "scheduling invariance." The second solution involves writing extra multiplexing code, because the hardware offers no support. Such

continued

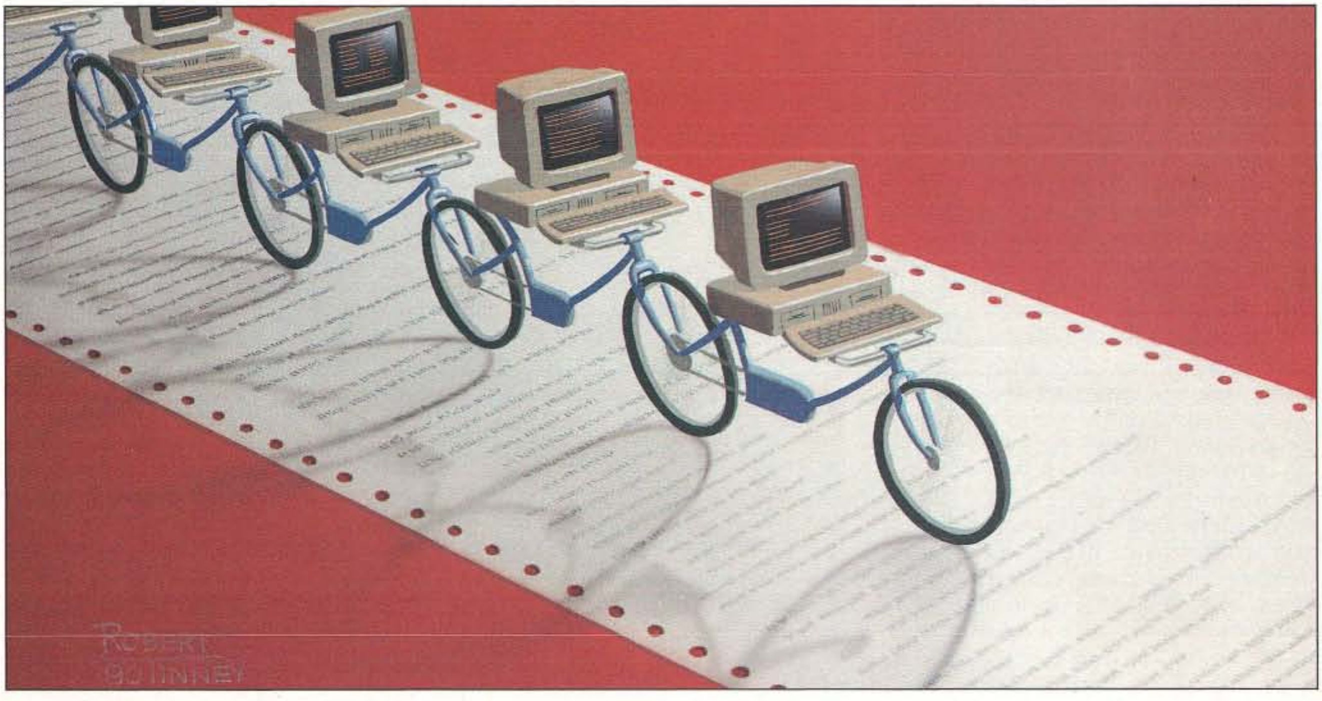


ILLUSTRATION: ROBERT TINNEY © 1990

software multiplexing is slow and tedious to write, and it distracts you from writing the main application program.

Designers of parallel supercomputers keenly feel this limitation of the transputer architecture. The *n*-dimensional hypercube has become a popular topology for parallel supercomputers, because it can minimize the lengths of the paths between processors. But even a four-dimensional hypercube requires six communications links per processor, while higher dimensions require more still. Implementing hypercubes using transputers has, until now, meant using several transputers at each node just to get enough link connectivity.

A Sneak Preview

During my recent visit to Inmos's research facility at Bristol, David May, the chief architecture designer, gave me a preview of the next generation of transputer hardware. The new processor that Inmos plans to have ready by 1991, code-named H1, incorporates several hardware enhancements to support faster operation and more sophisticated operating systems than do the current chips.

Most important, H1 incorporates a solution to the connectivity problem. To deal with this issue, Inmos could have added a few more on-chip links, but the total number would still have to be small, the constraint being the VLSI fabrication capabilities. Instead, Inmos has chosen the radical solution of adding multiplexing hardware so that the physical links can be shared transparently. Inmos is also designing a matching high-performance routing chip so that transputers can be connected by a full-blown packet-switching network.

Links between transputers will become *virtual channels*, and you can have as many of them as your program needs. Virtual channels can run between transputers that are not even directly connected by physical links, with the routing chips responsible for delivering messages efficiently to a named destination.

A good analogy is the public telephone network. When you call a friend's telephone number, the public network creates an electrical path between your phone and your friend's just for the duration of the call. It is not necessary for a permanent hard-wired connection to exist between them, as was once the case with old-fashioned office intercoms. More important, you do not need to specify any of the links. A long-distance call may get routed via several other cities, but you neither know nor care about this; the destination (i.e., your friend's phone number) is all that you need to specify.

When programming the current generation of transputers, you must explicitly allocate every message channel to a named link, and several such allocations may have to be made to get a message to a remote transputer. These conditions make your program dependent on the exact topology of the fixed network, and hence it is not portable to a network with any other topology. On the H1, two processes anywhere in a network can just use a named software channel to communicate, and the hardware will sort out the message routing. With this improvement, programs can be independent of the network topology and, thus, more portable.

Virtual channels can run between transputers not even directly connected by physical links.

Message Packets

The current H1 transputer design still incorporates only four communications links. But it also contains an on-chip communications controller that will support many virtual channels by dividing messages into packets and interleaving packets from several messages down a single link. The physical links of the H1 will be five times faster (100 megabits per second full-duplex) than the current transputer links. In addition, the packet system ensures more efficient utilization, so communication performance will be improved despite the sharing involved.

H1 splits up messages of arbitrary length into a sequence of 32-byte packets, quite unlike current transputers that send messages byte by byte. Mixing packets belonging to different messages (i.e., different virtual channels) requires that each packet have a header that says which virtual channel it is using. Every packet ends with a special end-of-packet (EOP) marker value, except for the last packet, which has an end-of-message (EOM) marker. This way, without needing extra logic to count packets, the hardware knows when a message is complete and allows for messages shorter than 32 bytes (and the last parts of long messages that may not fill a whole packet). Here is the structure of a packet:

<HEADER> <0..32 bytes of data>
<EOP/EOM>

To keep the communication synchronized, the receiver has to acknowledge every packet; the acknowledge packet is just a packet containing no data. Each virtual link contains two virtual channels, one to send data packets out and the other to receive acknowledgments back. A sending process cannot continue until its last packet has been acknowledged. Acknowledgment is sent as soon as the first byte of a packet has been received, a process that permits unbroken transmission of messages if the receiver is ready to input. Output requests are queued on each physical link, so the CPU does not have to wait while a packet is sent.

In case the receiving process is not ready to input a packet, the H1 chip provides a buffer for exactly one packet on each link. For the same reason, current transputers buffer 1 byte in a hardware register. On the H1, the buffering will be performed in memory rather than in a register, so that (memory permitting) any number of virtual channels can be set up on a single processor.

You could use the H1 just the way you use current transputers, by connecting some of its four links to those on other H1s and then sending messages "point to point" from one chip to the next. To fully exploit the virtual-channel concept, you need an extra chip, the C104 routing switch.

The C104 is a complete packet-switching exchange on a chip, similar in principle to a telephone private area business exchange. The C104 chip contains 32 transputer links and can route a message from any one of 32 H1 transputers to any of the others.

You don't have to connect 32 transputers to a C104; you might, for example, want to connect just eight transputers by all four of their links instead. Such a connection does not affect the number of channels that can be switched, since each link can carry any number of virtual channels anyway. However, with this scheme you would obtain a fourfold increase in the maximum available communication bandwidth. Then again, you might want to connect some of the C104's links to other C104 chips to make a larger and more complex switching network.

continued

JT FAX BY INTERQUAD

JUST THE FAX FOR YOU.

InterQuad's JT Fax eliminates the 'fax machine bottleneck' and lets you send and receive faxes from the privacy of your own PC.

It costs around 70% less than a desktop fax machine, and up to 50% less than other fax boards!

It utilises unique 'convert-on-fly' software which doesn't waste precious time or consume valuable hard disk space.

You can send and receive faxes without exiting your word processor, spreadsheet or other application. The menu-driven software is easy to use.

JT Fax can send and receive your faxes even when you're not there.

It also lets you display received faxes on-screen, pan, zoom, rotate and flip, save them to disk, or print them on a dot matrix or laser printer.

JT Fax can merge text and graphics files, so you can add your letterhead and signature to fax correspondence. The transaction log provides an automatic, detailed record of incoming and outgoing faxes. The fax directory holds thousands of phone numbers with quick search, update and autodial capabilities.

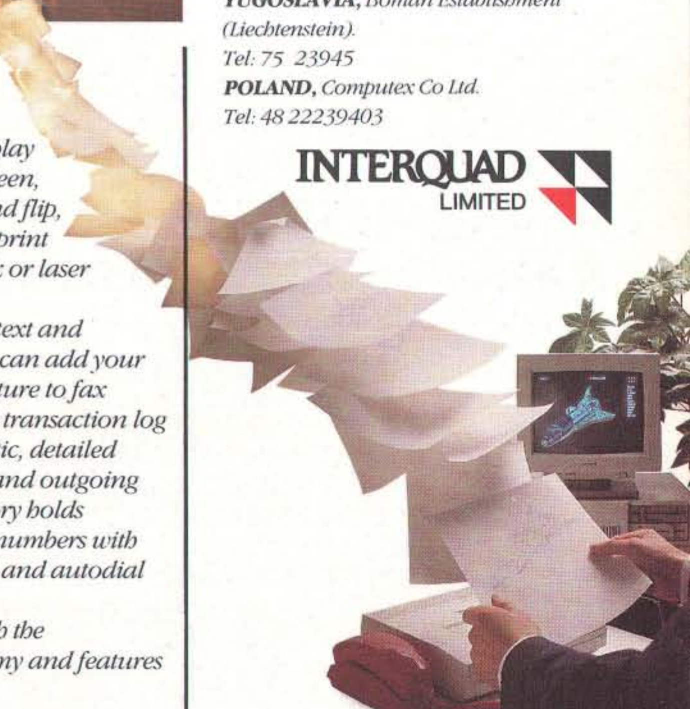
Nothing can match the convenience, economy and features of JT Fax.

It's Just The Fax for your PC.

INTERQUAD have distributors all over Europe

AUSTRIA, *Micropoint Warenvertriebs GmbH.*
Tel: 02236 82575
BELGIUM, *Sagitta B.V.B.A.*
Tel: 015 202322
CYPRUS, *Mechatronic Ltd.*
Tel: 02 444192
DENMARK, *Techware A/S.*
Tel: 42 94 80 33
HOLLAND, *Akam Electronics bv.*
Tel: (0) 79 443200
ICELAND, *Ortolvutaekni-Tolvukaup hf.*
Tel: 354 1 687220
ISRAEL, *Smart Systems Ltd.*
Tel: 03 322579
ITALY, *Tradinform S.r.1.*
Tel: 06 451911
NORWAY, *Dataimport AS,*
Tel: 05 314085
PORTUGAL, *Decada Equipamentos de Electronica e Cientificos.*
Tel: 01 410 3420
SPAIN, *SDI SA.*
Tel: 91 413 72 46
SWEDEN, *Dataimport AB.*
Tel: 08 716 94 55
Intertex Data AB.
Tel: 08 764 6410
SWITZERLAND, *Mini-Peripherals AG.*
Tel: 042 36 58 77
YUGOSLAVIA, *Boman Establishment (Liechtenstein).*
Tel: 75 23945
POLAND, *Computex Co Ltd.*
Tel: 48 22239403

INTERQUAD LIMITED



InterQuad Limited, 653/654 Ajax Avenue, Slough, Berkshire SL1 4BG,
England. Tel: (44) 753 36464/(44) 753 34421 ext: 139.
Telex: 847542 INTQAD G. Fax: (44) 753 77256.
Germany: InterQuad Computer GmbH. Tel: (49) 6102 17095. **France:** InterQuad S.A.R.L. Tel: (33) 1 46840515.

Circle 443 on Reader Service Card

The C104 contains a 32-by-32 crossbar switch to connect any of its links to any other, as well as some fairly simple logic for deciding the intended destination of each message that it receives (see figure 1). The chip does not need to contain a CPU or any significant amount of memory, thanks to the routing scheme that Inmos's designers have used.

Wormhole Routing

In most packet-switching networks, each routing switch inputs a complete packet and stores it internally, decodes its address information, and then forwards the packet to the next appropriate node. This scheme is not very suitable for high-performance transputer networks because it can cause relatively long delays between the output of a packet and its arrival at its destination (i.e., high latency), while also requiring the provision of substantial buffer memory on the C104 routing chip.

Inmos has chosen instead a technique called *wormhole routing*, in which only the header of the packet is read in and its address decoded. Then, if the required link is free, the rest of the packet is sent straight through from input to output as a stream without being stored at all.

This means that the header might be entering a new switch node while the body of the packet is still passing through previous nodes. Indeed, the header may not have entirely emerged from the sender yet, for in moderate-size networks, it will arrive at its destination before the sender has finished sending. In effect, a circuit has been opened from sender to receiver along which data is transmitted continuously, and which closes as the end of the packet is "pulled through." The wormhole analogy is founded on the observation that a worm crawling through sandy soil creates a hole that closes again behind its tail.

A wormhole routing node can pass only one packet at a time, so any other packets that need to use that node will be stalled until the node is cleared. Even so, given a good routing strategy, wormhole routing offers very low latency, and it means that the C104 need only buffer 1- or 2-byte headers instead of whole packets. Wormhole routing is totally invisible to message senders and receivers, since it exists at a hardware level beneath the send/acknowledge synchronization mechanism.

A complete routing strategy requires a routing algorithm to decide, by referring to the address contained in its header, which link a packet should be output to. Routing algorithms are a well-studied field, thanks to their enormous importance to the communications industry. A good routing algorithm should be complete (i.e., it must guarantee that every packet sent eventually arrives), deadlock-free, optimal (i.e., packets should follow the shortest routes), and of low overhead (i.e., packets should have small headers).

It also should be scalable (i.e., good for any size network) and versatile (i.e., good for any network topology). In addition, if it is to be implemented in inexpensive, fast hardware, a good routing algorithm should be simple. Simplicity is doubly important when you are using a fast wormhole router, to avoid degrading the latency time. No algorithms yet known fulfill all these requirements.

One standard solution is a *routing table*, which lists all the nodes and their

continued

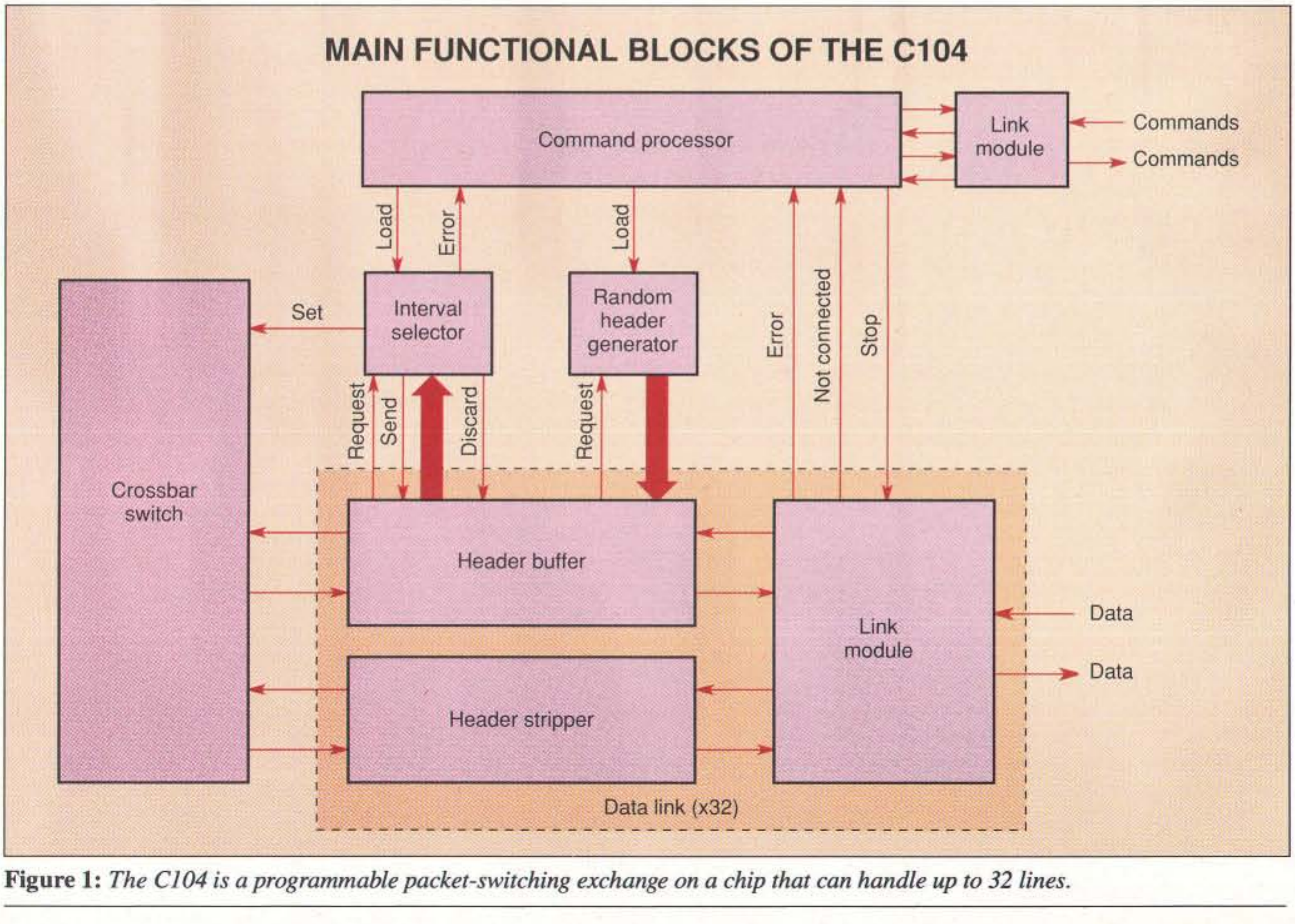
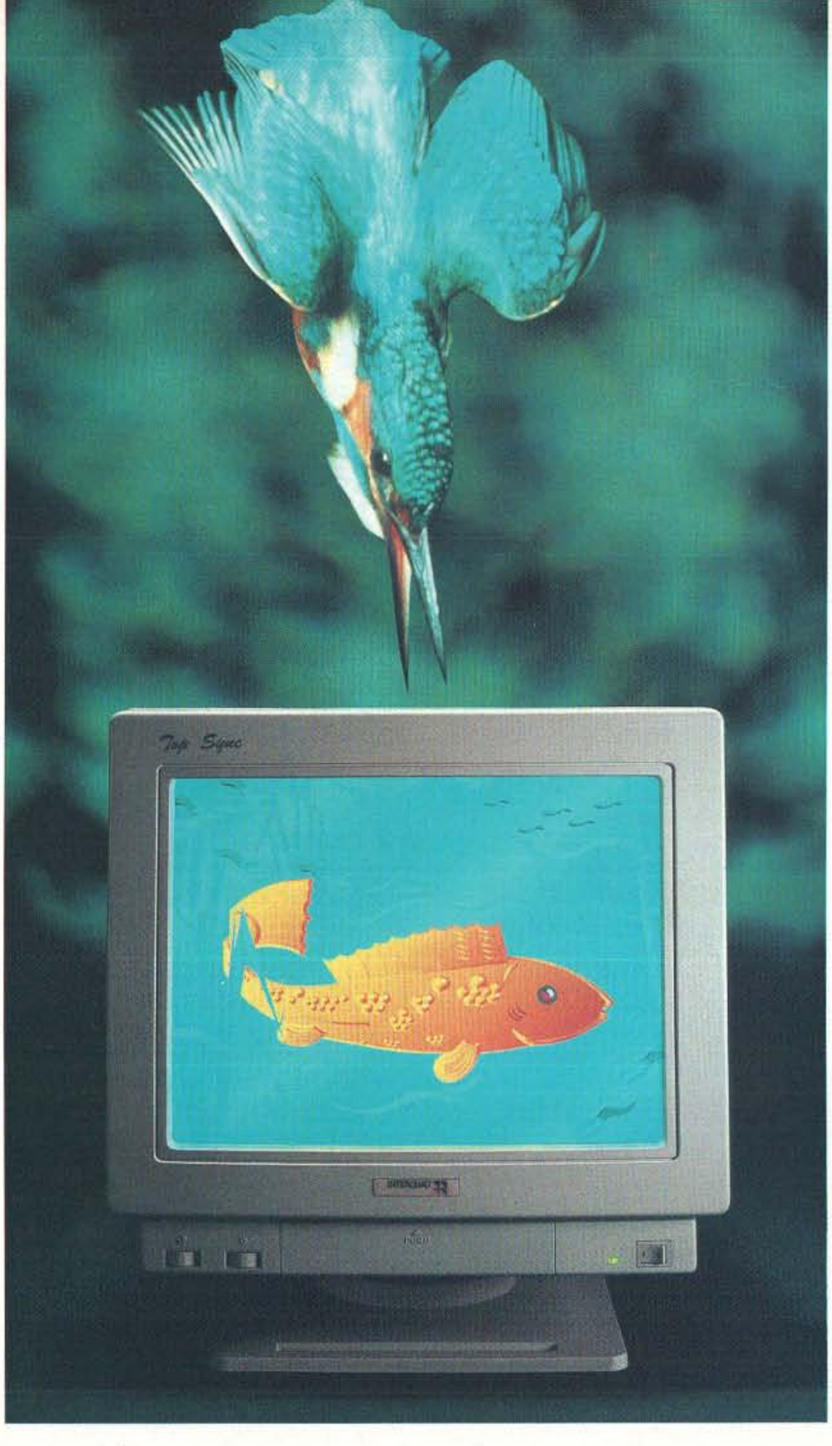


Figure 1: *The C104 is a programmable packet-switching exchange on a chip that can handle up to 32 lines.*



OUR BRILLIANT DISPLAYS CARRY A CLEAR MESSAGE.

Our range of data monitors is a brilliant collection of highly versatile units - each one ready to give you a precise and vivid display.

InterQuad provide exactly what you are looking for; sharp images, crisp text, and vivid colours, all presenting the information you need with faultless clarity.

Here is the reliability and the performance you require to meet present and future information display needs to perfection.

'Quality' is the ultimate message which shines out clearly from every screen. These display monitors are designed and manufactured to the highest standards, with every unit passing a series of stringent test procedures.

They also have 'the right attitude' to everyday working - all feature an integral tilt and swivel base, permitting choice of the best viewing position for comfort and convenience. The result: monitors which will be an asset to any office.

A BRAND NEW 15"! Look closely at our new autoscanning / TOP SYNC, flat screen 15- inch intelligent high resolution monitor! (Main illustration). It automatically synchronises 30 to 50 kHz and 50 to 80 Hz, compensating for picture size variation. It's compatible with all IBM PC and PS/2 graphics, including VGA, and supports 1024 x 768 non-interlaced.

InterQuad can give you a completely fresh angle on brilliant graphics, data, and whatever you want to see.

Contact us at the addresses below.

CM 1401
14" EGA with 640 x 350 resolution in EGA mode and 640 x 200 in CGA for XT/AT.

MS 1422
14" Multiscan colour monitor for XT/AT and PS/2 families of Personal Computers.

AM 1412
14" Analog Mono high resolution 720 x 480 ideal for DTP and WP type applications.

AC 1432
14" Analog Colour VGA monitor compatible with all VGA systems including the IBM PS/2 range.

INTERQUAD LIMITED

*INTERQUAD have international distributors: **AUSTRIA**, Micropoint Warenvertriebs GmbH. Tel: 02236 82575 **BELGIUM**, Sagitta B.V.B.A. Tel: 015 202322 **CYPRUS**, Mechatronic Ltd. Tel: 024 44192 **DENMARK**, Techware A/S. Tel: 42 94 80 33 **HOLLAND**, Akam Electronics bv. Tel: (0) 79 443200 **ICELAND**, Ortolvutaekni-Tolvukaup hf. Tel: 354 1 687220 **ISRAEL**, Smart Systems Ltd. Tel: 03 322579 **ITALY**, Tradinform S.r.l. Tel: 06 451911 **NORWAY**, Dataimport AS, Tel: 05 314085 **PORTUGAL**, Decada Equipamentos de Electronica e Cientificos. Tel: 01 574984 **SPAIN**, SDI SA. Tel: 01 413 7246 **SWEDEN**, Dataimport AB. Tel: 08 716 94 55 **SWITZERLAND**, Mini-Peripherals AG. Tel: 042 36 58 77 **YUGOSLAVIA**, Boman Establishment (Liechtenstein).Tel: 75 23945 **KENYA** ,Computech Consulting Services Ltd.Tel; 02 721314*

InterQuad Limited 653/654 Ajax Avenue, Slough, Berkshire SL1 4BG, England, Tel: (44) 753 36464/(44) 753 34421 ext. 139 Telex: 847542 INTQAD G. Fax: (44) 753 77256 Germany: InterQuad Computer GmBH Tel: (49) 6102 17095. France: InterQuad S.A.R.L. Tel: (33) 1 46840515

Circle 444 on Reader Service Card

connections like a telephone directory; this is complete, optimal, and versatile, but not cheap, fast, or scalable. Another common solution is *bit erosion*, in which a bit from the header is consumed at each decision node; this is complete, cheap, fast, and optimal, but not versatile or scalable, as it implies a fixed-size binary tree structure.

Interval Labeling

Inmos chose a comparatively new algorithm called *interval routing*, which is complete, deadlock-free, inexpensive, fast, and scalable, and can be near-optimal or versatile depending on how it is used. Each transputer (or other destination node, such as a gateway to another network or a peripheral chip) in the network is labeled with a number, so a network with *n* transputers could be labeled $0,1,2 \ldots n-1$. This number is used as the destination address in a packet's header.

In each routing switch, every link is labeled with an interval of possible header values, and packets are output via the link within whose interval its header value falls. Figure 2 shows an example for a small network of four transputers and routing switches.

The interval notation $[0,3)$ should be read as meaning that a header value must be greater than or equal to 0 and less than 3 to lie within this interval. Intervals are nonoverlapping and numbered so that every header falls into just one interval. If you don't see how the scheme works, try routing some trial packets on figure 2 (try one from T1 with header 3).

In effect, each interval says, "The subtree containing all these processor numbers lies in this direction." The attraction of interval routing for the hardware designer is that it can be implemented with just a single comparison operation. Thus, the C104's logic consists of little more than a pair of comparators and interval registers for each link. The C104 can use 1- or 2-byte headers so that up to 65,536 transputers can be routed in a single network.

Of course, the key to a successful interval-routing scheme is the choice of the intervals at each node. If you try an arbitrary interval labeling, it will probably contain cyclic paths so that some packets will become trapped and never reach their destinations.

However, algorithms exist that will produce valid interval-labeling schemes for any network—that is, algorithms that deliver all packets to their destinations. One such algorithm is shown in pseudocode form in the text box "Algorithm for Interval-Labeling Any Network" on page 10. Better still, the labeling produced by this algorithm can be proved to be deadlock-free. However, the resulting routing will only be optimal (i.e., will have the shortest possible paths) if the network is a tree.

It is known that no optimal interval-labeling scheme for an arbitrary network can exist, and the problem of constructing the *best* interval-labeling scheme for an arbitrary network remains as yet unsolved. Fortunately, optimal, deadlock-free interval-labeling schemes *are* known for a range of regular network structures, such as rings, trees, and two-dimensional arrays. Optimal schemes can be constructed from these for most of the structures you might want to use, including grids and hypercubes of any dimension.

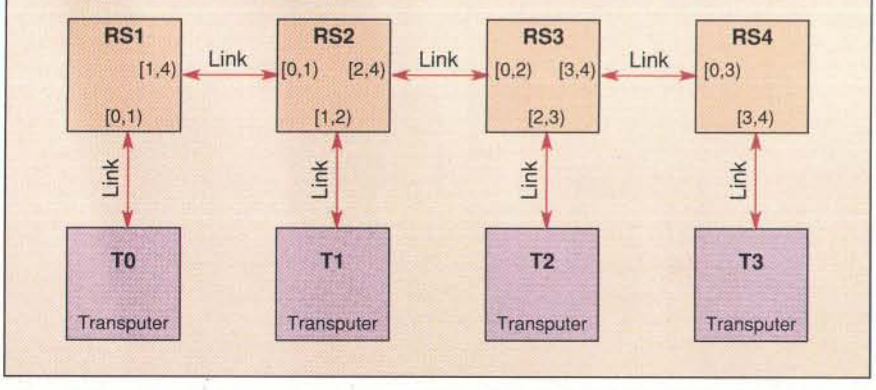


Figure 2: *Interval routing works by labeling each link from a switch with a numeric interval that includes the addresses of all those destinations lying in the subnetwork accessible via that link.*

Hot Spots

Although an interval-routing scheme can be guaranteed free from deadlock, it may still succumb to *hot spots*. When too many messages get routed through the same node, most arriving packets will be stalled for an unpredictable length of time, drastically reducing the throughput; such a node is called a hot spot. This is quite different from deadlock, which is a logical error that results in messages being stalled forever and is a property of the network topology and the routing algorithm rather than the application. For any network topology you can think of, it's likely that there is an application algorithm that can produce hot spots.

You can avoid hot spots by evenly distributing the network traffic, and you can program the C104 to perform this distribution. Routing becomes a two-phase process in which the packet is first dispatched to a randomly chosen node, and from this node, the message is sent to its final destination—the scheme is called *universal routing*. It can be viewed as a technological version of that old country joke that ends "If oi was you, oi wouldn't start from here."

Obviously, universal routing will increase a network's latency and reduce its maximum throughput, but its use guarantees that the worst-case performance is not far below the maximum. With hot spots, the worst-case performance can worsen by orders of magnitude, so this trade-off is often highly cost-effective. Physically, the universal-routing scheme works by adding an extra random header to the front of each packet, which is stripped off again inside the random intermediate node. (Actually, a further trick is necessary to avoid deadlock in a universally routed network, but the explanation is too long to go into here.)

You can also join several networks together by adding extra headers. One of the destination nodes in a network can be a gateway into another network, rather than a transputer. This node can be programmed to strip off the first header (containing its own address) from an arriving packet to reveal a second header that is a virtual address in the adjoining network. You can carry out this process as many times as you like to build networks of any size.

One of the drawbacks of plain interval routing is that, in general, you do not know what route any packet will take. For some applications, you might want to directly control the routing to entirely avoid message conflicts. You can use an extreme case of the multiheader trick to

continued

"A step into previously uncharted territory for 33 MHz machines..."

InfoWorld Magazine

In test after test (with results published in InfoWorld, PC Week, and PC Magazine) our machines have out performed competitors like Compaq, Zenith and IBM, yet our prices are 30% to 50% lower.

Our PC workstations are designed for optimum performance of CAD/CAM/CAE applications, desktop publishing and multi-user, multi-tasking such as Unix, Xenix, OS/2, and Novell operating systems.

Fortron Diskless Workstations are easily expandable, have the smallest footprint, lowest profile and leanest prices on the market.

Our 386-33 file server was ranked in the top five by PC Week! InfoWorld raved about its "flawless hardware and software compatibility", calling it "a step into previously uncharted territory for 33 MHz machines".

As one of the first to ship Intel 80386 based personal computer in the world, Fortron/Source has manufactured a complete line of PC's in California since 1983. We are now seeking partners and distributors in your area to help us grow.

Circle 434 on Reader Service Card

Interested parties, please contact us at:
Tel: (415) 373-1008, Fax: (415) 373-1168,
Telex 559291, or at our address:

FORTRON/SOURCE

6818-G Patterson Pass Road
Livermore, CA 94550b

FORTRON/SOURCE crosses all borders!

with speed, compatibility and diskless workstation design

Fastest 33MHz servers with one LAN adapter:

Fortron/Source	58:30 √
Compaq	59:10
Zenith	59:53
Network Connection	60:08

√ Least clock time indicates fastest computer.

Diskless Workstations available immediately from Fortron/Source

Models	CPU	Speed / Memory	Model	CPU	Speed / Memory
NetSet 100	8088-1	10MHz / 640K	NetSet 300	80386SX	16MHz / 1MB
NetSet 200-12	80286-12	12 MHz / 1MB	NetSet 400-20	80386-20	20MHz / 1MB
NetSet 200-16	80286-16	16 MHz / 1MB	NetSet 400-25	80386-25	25MHz / 1MB

Diskless Workstations Ranging from 8088–10 MHz to 80386–25 MHz

Algorithm for Interval-Labeling Any Network

First, cover the network with a spanning tree, which includes all the terminal links. Remove any leaf nodes without any terminal links, and remove any duplicate links between nodes of the tree. All links that are not part of the tree are given intervals with the upper and lower limits the same so that they can never be selected. Now label the links in the spanning tree as follows:

Let N be the total number of terminal links of the network. At all times, let i be the number of terminal links labeled so far (i is initially 0). Starting from the root node of the spanning tree, for each node V, set jv to the current value of [i+1) (incrementing i each time). Then pick an outgoing link of the tree from V and give it the interval [i+1, a), where a is to be determined later. Proceed to the connected node and repeat this procedure until a leaf node of the spanning tree is reached and all its terminal links are labeled.

Now backtrack. Each time a link is traversed up the tree, label the return link to the tree with the pair of intervals [0, jv), [i+1N). Note that if the subtree that was just labeled contains the last leaf node in the tree i+1=N, you can discard the first interval. Having backtracked to the previous node, V, replace the undetermined a_v with i+1 (note that the value of i is different from when the lower bound of the interval was assigned, because terminal links have been labeled since then). Now pick an unlabeled branch of the tree, give it the interval [i+1, a), and proceed until all the subtrees have been labeled.

This algorithm is formalized in the recursive procedure shown in listing A. The algorithm is invoked by picking a terminal link T of the root node R, setting i to 0, and calling LABELTREE (i, T, R, N).

Listing A: *This recursive procedure (algorithm) is invoked by picking a terminal link* T *of the root node* R, *setting* i *to* 0 *and calling* LABELTREE (i, T, R, N).

```
PROCEDURE LABELTREE (VAR i, VALUE L, U, N)
VAR j :
BEGIN
  j :=i+1;
  WHILE there are unlabeled terminal links;
    BEGIN
      choose an unlabeled terminal link;
      label it with [i,i+1);
      i :=i+1
    END;
  WHILE there are any unlabeled links at this node
    BEGIN
      choose an unlabeled link K, label it [i+1, a);
      Let V be the node connected by K;
      LABELTREE (i, K, V, N);-note that this changes the
              value of i
      replace it with i+1;
    END;
  IF L is not terminal THEN-L will only be terminal when we
              have finished;
    BEGIN
      label L with [0,j);
      IF i+1 <> N THEN label L with [i+1,N) as well;
    END;
END;
```

explicitly route packets by adding a header for each routing chip on the chosen path; each node strips its own header to reveal the next header and then passes on the packet. Such is the efficiency of interval routing that this routing technique is usually less efficient, despite the lack of conflict.

Full Occam

The C104 contains no processor. "Programming" it, by sending signals down a separate monitor link, is simply a matter of setting up the header length, interval values, and the flags that control the randomizing and stripping of headers. To most programmers, the routing mechanism I described above will be transparent, and the network will behave as if you could send messages from any transputer to any other transputer even when they have no connection.

Packet switching will permit the removal of certain restrictions in Occam, which is the language used to program transputers (see my article "Occam II" in the October 1989 BYTE). The present version of Occam is a static language in which all the resources needed by a program must be determined at compile time; thus, Occam programs cannot spawn new parallel processes on remote processors at run time. What's more, the topology of distributed programs is severely limited by having only four channels available to other processors. The programmer has to explicitly allocate each channel to a physical link when compiling the program and cannot alter these allocations without recompiling.

The introduction of the H1 and C104 will allow Full Occam to be implemented. This full version will look just like current Occam, but, for example, you will no longer need to use PLACE to allocate channels to links. You will be able to declare as many channels as you need and let the routing system handle the necessary connections. Processes will no longer have to be PLACEd on named processors, because the compiler will be able to place them itself. Such programs should be portable to any routed transputer array with sufficient processors, but their efficiency may be reduced on networks of unsuitable topology.

The next step could be Dynamic Full Occam. In this version, the restrictions imposed by compiler allocation would be removed altogether, allowing recursive processes, replicators with run-time-determined indexes, and reallocation of processors at run time. The H1 architecture contains several enhancements that make such a development feasible.

Other H1 Enhancements

Although the virtual-channel mechanism is by far the most exciting, the H1 processor contains a number of other enhancements to make life easier for operating-system designers and to offer better support for languages such as C and Ada.

Like the present T800, the H1 will

continued

Circle 462 on Reader Service Card

have an on-chip FPU and four communications links. The core processor will use on-chip caching and a DRAM controller that will support static column memory access modes. These features, in combination with improved fabrication technology, show promise of boosting peak performance up to 100 million instructions per second and 20 million floating-point operations per second. Inmos proposes to incorporate a memory protection scheme that allows each process to have access to four protected regions of memory. These protected regions can be used for code, data, stack, and heap when implementing operating systems such as Unix.

An important innovation is the provision of a many-to-one channel instruction (currently, transputer channels are strictly one-to-one). A popular use for this feature will be to allow many processes to share a common code resource, such as a file server or a graphics engine, in a more efficient way than Occam's current ALT construct does.

A many-way ALT has to spend much of its time connecting and disconnecting channels, whereas a many-to-one channel queues incoming messages on a single channel instead. C programmers are more used to performing this sort of task using N-valued semaphores, and to please them, two new instructions, `signal` and `wait`, have been introduced to ease the implementation of semaphores.

Finally, Inmos has added hardware support for exception handling with a full implementation of IEEE floating-point error handling.

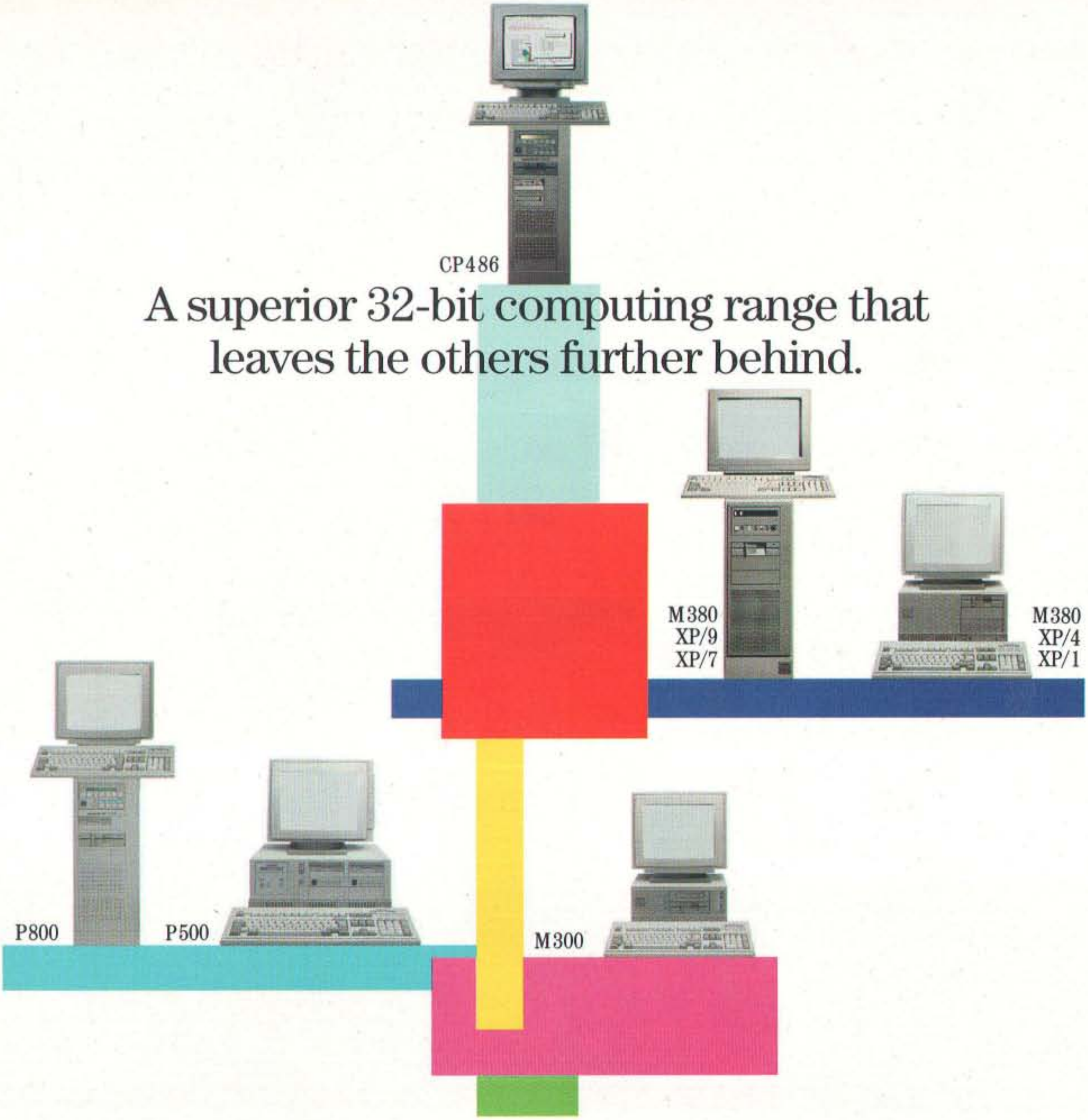
Another Giant Step...

Although neither the H1 nor the C104 exists in silicon in its final form, Inmos has prototypes of various subsystems and simulations of the whole chips running now. The simulation results suggest that H1/C104 networks will have a capacity under heavy loading that is very close to the theoretical maximum.

These same results also imply that the average message delay remains well under control, barely doubling from 12 to 27 microseconds as you go from a 64- to a 16,384-node hypercube. If these simulated effects turn out to be valid, the H1 will represent an even bigger step toward producing truly general-purpose parallel computers than did the original transputer. ■

Dick Pountain is a BYTE consulting editor, technical author, and software consultant living in London, England. You can contact him on BIX as "dickp."

A superior 32-bit computing range that leaves the others further behind.



The latest achievement in Olivetti's 32-bit range is the CP486 - the first Computing Platform. This machine gives you the ease of use and compatibility of a PC, the power and functionality of a minicomputer, together with the universality of an established standard.
Olivetti's 32-bit range is already recognised as the most comprehensive and technologically advanced on the market. The CP486 is just the latest arrival to stand out from the competition, is EISA-based (Extended Industry Standard Architecture) and gives a new lead in IT development. A new lead in the direction which Olivetti has always marked out as its own: freedom of choice for you, the user.
When you look at Olivetti's 32-bit computer range, from the M300 to the M380/XP family and now to the CP486, you know you're looking at winners. And you realise that these are the very winners you've been waiting for.

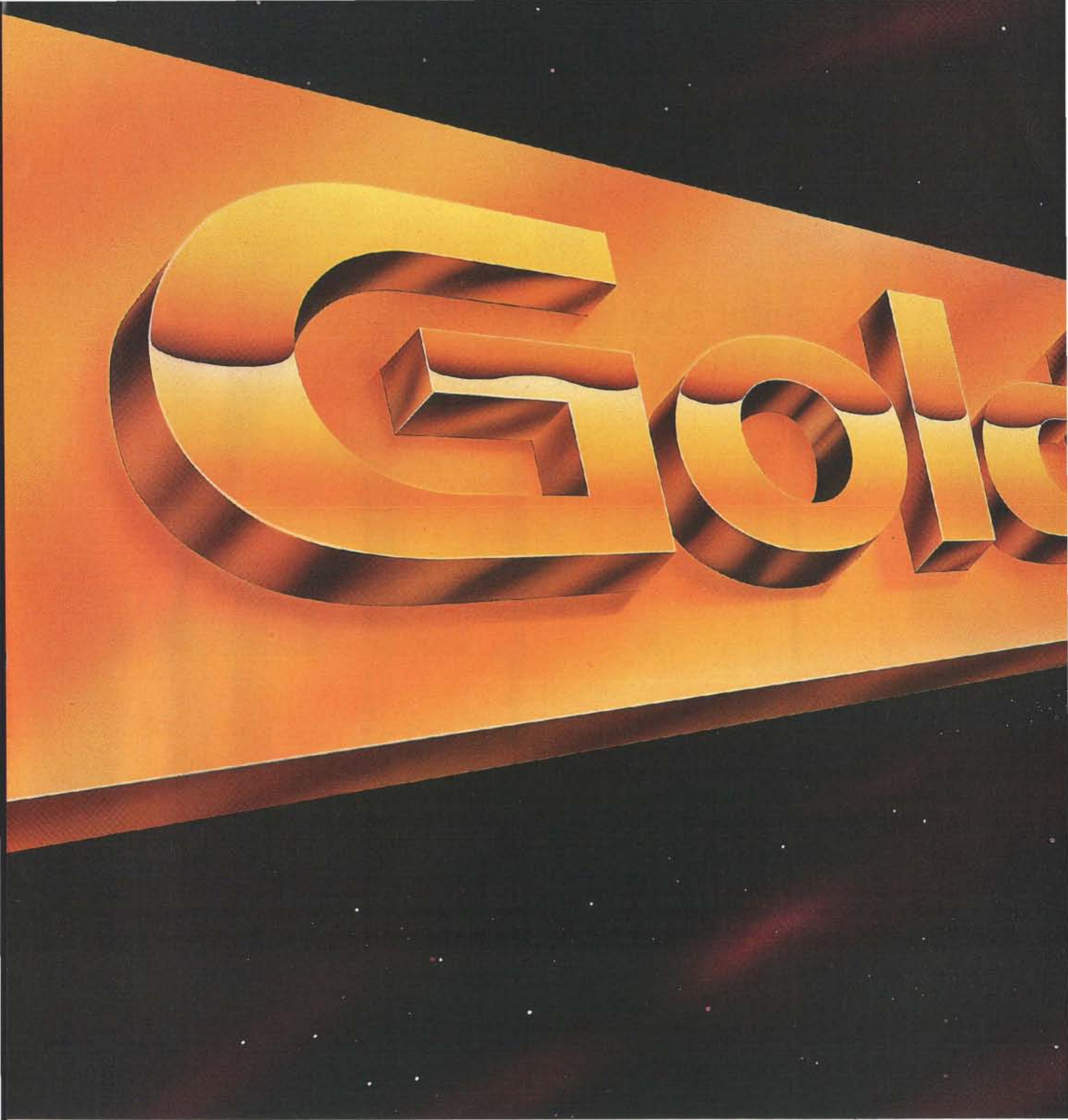
OLIVETTI PC RANGE								
Models	M300	P500	P800	M380 XP/1	M380 XP/4	M380 XP/7	M380 XP/9	CP 486
Chip	386SX*	386SX*	386*	386*	386*	386*	386*	i486*
Speed (MHz)	16	16	25	20	25	25	33	25
Architecture	AT	MCA**	MCA**	AT	AT	AT	AT	EISA
Operating Systems	MS-DOS• SCO▲ XENIX• MS OS/2• SCO▲ UNIX••							MS-DOS MS OS/2 SCO UNIX

Our force is your energy

olivetti

*i486, 386, 386SX are trademarks of Intel Corp. ** MCA is a trademark of International Business Machines Corp. • MS-DOS, MS OS/2, XENIX, are trademarks of Microsoft Inc. •• UNIX is a trademark of AT&T in the U.S.A. and other countries. ▲ SCO is a trademark of The Santa Cruz Operation Inc.

Circle 463 on Reader Service Card



Lucky-Goldstar, one of the 4 major conglomerates in Korea, proudly presents... **Goldstar**, a new brand with over 30 years of experience.

Goldstar has been a part of the electronics revolution, producing a complete spectrum of consumer and industrial products, often for major foreign OEMs.

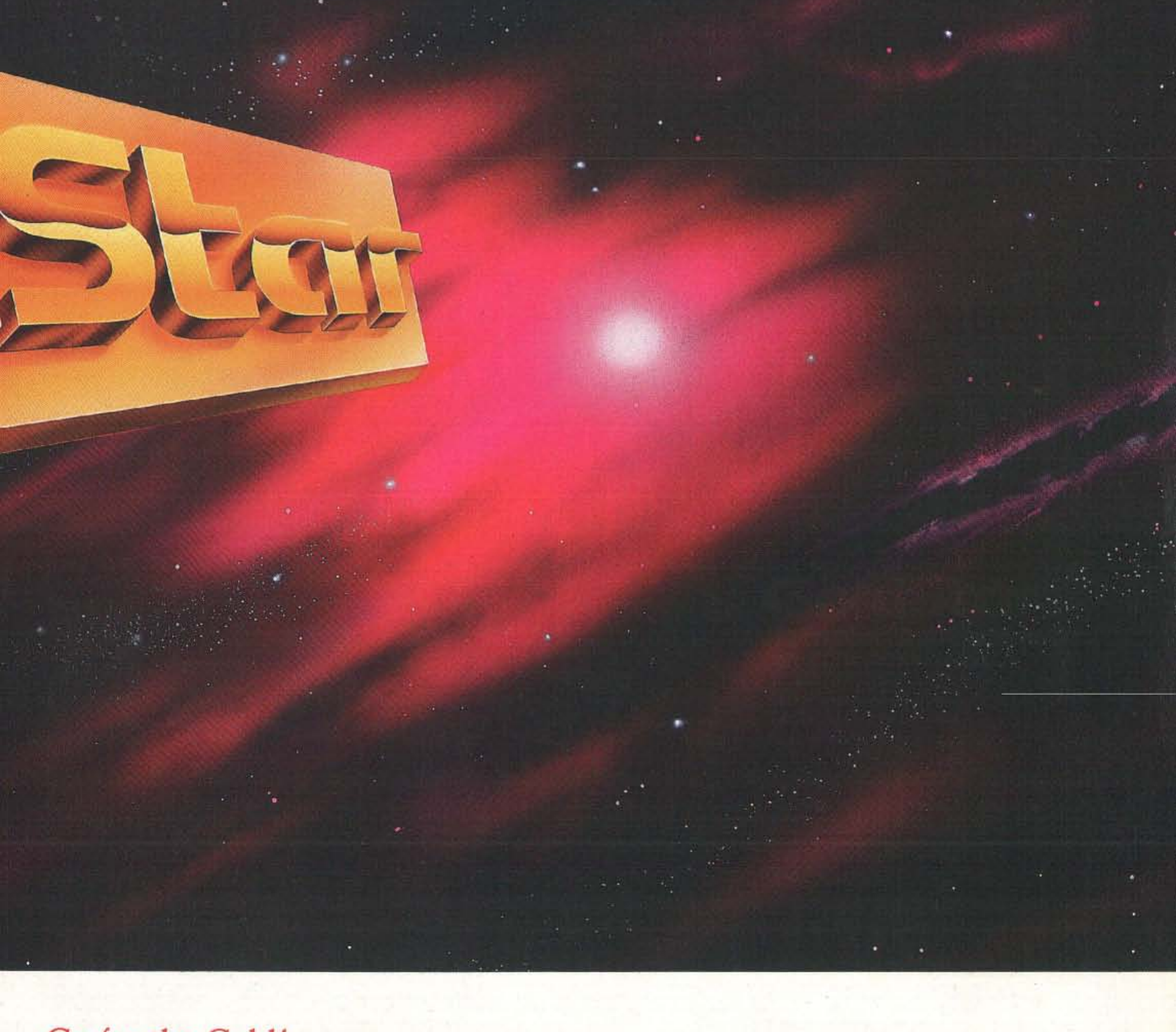
Now we're introducing our own line of IBM compatible computers. From entry-level XT®s to more powerful desktop and laptop AT®s to 386™ file servers and PS/2® model 55's. And monitors in CGA, EGA, VGA, CAD/CAM, multi-scanning, and DTP models to match your customer's needs.

Goldstar expertise doesn't end at the computer screen. We make office automation equipment too. From fax machines to LBPs (lazer beam printers) to electronic typewriters. Products full of quality and value. All at competitive prices.

There's a new "star" on the office automation horizon. One that has been there. One that will be there in the future. Reliable, modern, innovative.

All names mentioned are trademarks or registered trademarks of their respective companies.

Goldstar... A quality manufacturer backed by a $20 billion corporation. Dedicated to building strong partnerships around the world.



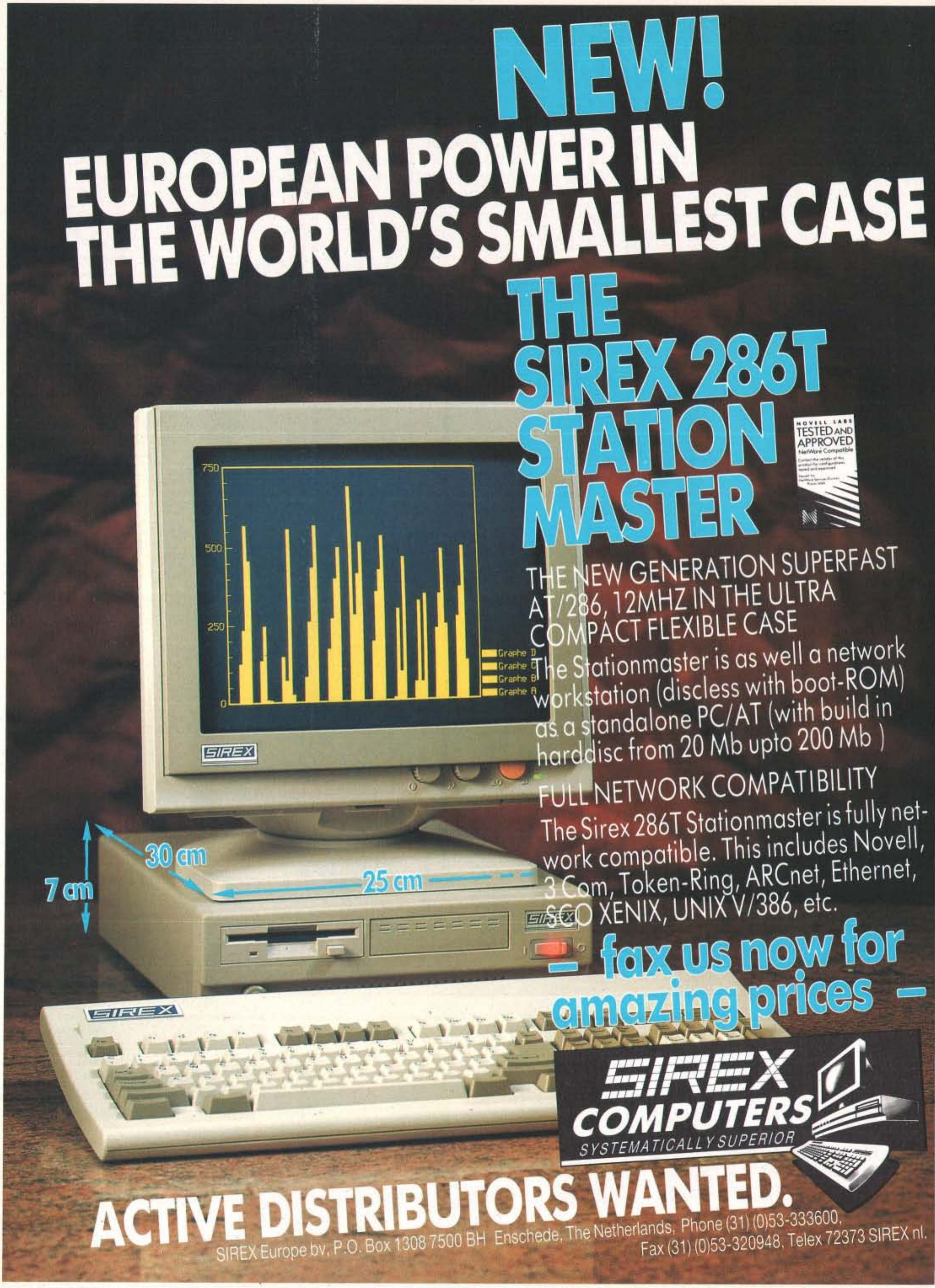
Go for the Gold!

GoldStar
The Brightest Star in Electronics

Yoido P.O. Box 335/Seoul Korea
Tel: (2) 780-4176
Cable: GOLDRADIO SEOUL
Tlx: GSRADIO K23751/3
Fax: (2) 787-3400

Overseas Network ■ U.S.A. GOLDSTAR TECHNOLOGY, INC. HEAD OFFICE Tel: (408) 432-1331 Fax: (408) 432-6053 GOLDSTAR TECHNOLOGY, INC. NEW YORK OFFICE Tel: (201) 816-2147 Fax: (201) 816-0636 GOLDSTAR TECHNOLOGY, INC. LOS ANGELES OFFICE Tel: (213) 404-1224 Fax: (213) 404-4636 ■ U.K., C&C LONDON OFFICE Tel: (753) 691888 Fax: (753) 693061 ■ W/GERMANY, C&C DUSSELDORF OFFICE Tel: (2154) 492167 Fax: (2154) 427777 ■ FRANCE, C&C PARIS OFFICE Tel: (1) 47-66-1111 Fax: (1) 47-66-1341 ■ HONGKONG, C&C HONGKONG OFFICE Tel: (5) 8456787 Fax: (5) 8459416 ■ JAPAN, C&C JAPAN OFFICE Tel: (3) 505-0929 Fax: (3) 582 7948

Circle 437 on Reader Service Card



Circle 475 on Reader Service Card

Learn Navigation on Your IBM PC

PC Maritime offers a software program called **PC Navigator 2** that teaches yachtsmen the basic skills of navigation. The program simulates a cruise in three dimensions, real time, and color, if you use a suitable monitor. In addition, it incorporates weather, tides, and realistic yacht performance; it emulates a Decca/Loran receiver to provide practice in electronic navigation, too.

PC Navigator comes in a large plastic ring binder that holds the program disks (it comes on both 5¼- and 3½-inch floppy disks), a user's manual, a 64-page paperback book on navigation, and a real navigation chart for the Channel Islands sailing area. A second sailing area (i.e., Martha's Vineyard/Nantucket Sound in the U.S.) is available as an option. The program is not copy-protected, and to install it, I simply copied the distribution disks.

Like so many graphical programs nowadays, PC Navigator uses Metagraphics' MetaWindow driver to support every graphics adapter known to science, and it automatically detects your adapter at program boot time.

When you start PC Navigator, you are invited to accept a disclaimer that says the program is for training purposes only and not for use at sea or for planning real passages; the program will load only when you answer "yes."

The main screen consists of five tiled windows with a menu bar along the top and a message line at the bottom. The main window shows a chart of your current sailing area (normally the Channel Islands) and marks the current position of your boat. You can zoom in on this chart by pointing with the cursor keys or mouse.

Along the bottom of the chart is the instrument panel, which is divided into six sections and displays the current compass reading, log (i.e., distance traveled), speed, depth of water, apparent and true wind direction and speed, barometric pressure, and the Velocity Made Good, which is a measure of the boat's actual speed into the wind.

To the right of the chart are the front, side, and plan views of the boat, which show you the angle of heel, the amount of sail set, and the position of the sails relative to the wind. At the far right edge is an information panel with miscellaneous displays, such as the elapsed time and the status of the auxiliary engine.

To control PC Navigator, you use a combination of function keys and pull-down menus, which you summon by pointing or by key presses. I was disappointed that I could select from menus only by moving the cursor bar; there were no initial-letter shortcuts. To start a passage, you must set up the simulation conditions using the menu system; these include the initial position, weather, tides, and any waypoints (i.e., points to aim for) that you want plotted on the chart. You can place the initial position and waypoints by pointing using a special cross-hair cursor. You seldom need to type numbers into PC Navigator; instead, you either point or use the plus (+) and minus (−) keys to alter defaults.

Once under way, you steer the boat using the cursor keys and adjust the propelling power by reefing sails or altering the motor throttle. You can also heighten the realism by selecting the three-dimensional mode, which gives you a captain's eye view of the seascape through which you are sailing. Unlike most flight simulators, this 3-D view is not animated, the simulation being suspended until you return to the main screen; yachts move so slowly that progress would be hardly noticeable in any case. You will probably spend far more time looking at the chart view. However, the 3-D mode lets you practice visual navigation, as it contains a picture of a hand bearing a compass with which you can take bearings on landmarks.

For more high-tech navigators, there's a simulation of a Decca radio navigation receiver, which pops up like a desk accessory. You just type in the longitude and latitude of one or more waypoints (i.e., points that your plotted course is supposed to pass through), and the Decca computes the range, bearing, and arrival time to each waypoint from your current position, letting you check for deviations.

The chart view plots the course you are ostensibly sailing as a red line. You can check your navigation at any time by pressing the F5 key, which shows the actual course as a dotted line; this may differ from your intended course thanks to tides, leeway, or incorrect compass correction.

PC Navigator provides a logbook into which you should enter your position at intervals as on a real voyage, and you can also enter position fixes onto the screen chart. The F7 key allows you to toggle the symbols that mark sea lanes and obstacles on and off to prevent the chart from becoming too congested.

The simulation normally takes place in real time, which is about as interesting as watching marine varnish dry, so PC Navigator provides a jump command that lets you jump forward in time. Voyages tend to involve making a course alteration, jumping 30 minutes, making another alteration, and so on.

PC Navigator provides a safe and painless way to learn marine navigation, and, especially when it is used with a mouse, it is easy to operate. In some ways, PC Navigator is the seagoing equivalent of the Microsoft Flight Simulator, although it lacks some of the latter's more sophisticated features, such as a choice of craft. However, sailing is intrinsically less exciting than flying in PC simulation, so PC Navigator is more suitable for serious teaching than as an adult game.

—Dick Pountain

THE FACTS

PC Navigator 2
£99; £45 for extra chart areas.

Requirements:
An IBM PC with 512K bytes of RAM, DOS 3.3, and a graphics adapter.

PC Maritime Ltd.
The Computer Complex
Somerset Place
Stoke
Plymouth
Devon PL3 4BB
UK
44-752-550341
Inquiry 884.

continued

Near-Laser Print Quality from a Bubble-Jet Printer

Bubble-jet technology is a variant of ink-jet technology in which ink droplets are delivered to the paper as a line of bubbles in a fine capillary. Mannesmann Tally's **MT91** is a high-quality page printer that utilizes this technology, but you don't need to understand it to use the MT91; what you get is silent operation, near-laser print quality, and almost limitless print-head life.

Setting up the MT91 proved easier than any printer I've used—I just plugged in the power and computer cables and then switched it on. Later, I discovered two wire paper-stacking guides that I needed to install, but the printer worked just fine without them. The MT91 is large by virtue of its 16-inch-wide carriage, and it appears to be very well constructed from high-quality materials.

You can add several options to the MT91 by plug-in modules. A long narrow trap door along the front of the case opens to expose the ink cartridge, two slots for external font cartridges, and a control capsule that makes the MT91 emulate other printers. Mine came with an IBM Proprinter capsule, but an NEC P7 capsule is available, too. Changing the ink cartridge is like inserting a video cassette into a VCR—much easier and cleaner than either a dot-matrix ribbon or laser toner cartridges. Each cartridge is good for about 1 million characters, and a warning light comes on to tell you when it is almost empty. The print quality remains perfect "to the last drop" and does not deteriorate as it would with a dot-matrix ribbon.

The MT91 is primarily a sheet-fed printer, although you can buy an optional tractor feeder for continuous stationery. The built-in sheet feeder holds 100 sheets of paper, up to 14 inches wide. The nondetachable feeder is an inclined tray just behind the print carriage. The MT91 turns printed paper through 180 degrees and stacks it on a second deck above the feed tray. It is also possible to hand-feed single sheets into a middle slot, thereby avoiding the need to empty the tray to change letterheads. As long as I aligned the stack of paper carefully when loading, paper feeding was reliable, and I had no jams.

The only noise you hear when the MT91 is printing is the swoosh and click of the print carriage, which, like any dot-matrix printer, has to traverse the paper line-by-line. A slightly startling feature is that the print head occasionally starts moving when the machine is standing idle; it does this to clean itself and avoid clogging.

The print head of the MT91 is a row of 48 ink nozzles, making it the equivalent of a 48-pin dot-matrix printer. There are two modes: fast, which gives you 18 by 48 dot characters at 220 cps, and quality, which gives you 36 by 48 dot characters at 110 cps.

The character forms are excellent in both modes, every bit as good to the eye as laser-printed ones; fast mode is slightly grayer, though, because the dots do not fully overlap, allowing a little white to show. To get an estimate of its speed in real applications, I printed a 1000-word (two pages, single-spaced) document, which took 97 seconds in fast mode; this differs considerably from the manufacturer's claimed print speed, largely because the MT91 feeds sheets extremely slowly. On the brighter side, thanks to the MT91's 32K-byte input buffer, my computer was freed up immediately.

Like modern dot-matrix printers, the MT91 has many fancy type styles built in, including quadruple-height and quad-size characters as well as the usual underline, boldface, subscripts, and so on. In particular, it has laser-style shaded and reversed black-to-white print modes, which are selectable from the front-panel switches or in software. Both are exceptionally even in tone. To my surprise and delight, PC-Write's print configuration file for the IBM Proprinter reproduced all the fonts correctly without alteration, as well as IBM block graphics characters. The MT91 supports all the usual European language character sets via DIP-switch settings or software, although the precise details depend on which emulation control capsule you have installed.

The MT91 supports downloadable fonts using a 64K-byte internal RAM buffer. The built-in ROM character set is Courier, but you can plug in one or two external font cartridges under the front flap; I tried Gothic and Orator. To use an alternative font, you have to download it to RAM by pressing the Font button on the front panel until a beep tells you downloading is finished after 5 seconds or so. Only one alternative font can be resident at a time, although you can change fonts by downloading under software control, if your software permits.

The MT91 can also act as an Epson-compatible graphics printer with resolutions of up to 360 dpi. The results are of superb quality with uniformly black characters and crisp, open tones.

I grew fond of the MT91 during this test. Its print quality is as good as a laser printer, but it is much easier to use with standard IBM PC software than any Hewlett-Packard LaserJet compatible, because it behaves like a dot-matrix printer. Also, it's quiet and inexpensive to run, consuming an ink cartridge every million characters and a print head every 100 million characters. Its major drawback is the slow sheet feeding, which makes it unsuitable for printing long documents or where time is a consideration. Otherwise, it's an excellent replacement for a daisy-wheel printer in small business applications or as an alternative to a low-end laser printer.

—Dick Pountain

THE FACTS

MT91
£799; font cartridge, £75;
ink cartridge, £13;
serial interface, £60;
tractor-feed paper handler, £87

Requirements:
A computer with a Centronics parallel printer port; an RS-232C serial interface is optional.

Mannesmann Tally Ltd.
Molly Millar's Lane
Wokingham
Berkshire
UK
44-734-788711
Inquiry 885.

Noticed by its Absence

Glockenspiel C++ 2.0

We nearly added: "We took the time to get it right" - but it wouldn't have told you the whole story.

Glockenspiel was first to launch a commercial C++ compiler when AT&T released its initial C++ standard. Recently C++ 2.0 was released - but we held back from rushing out a commercial implementation. Why?

We wanted Glockenspiel C++ to bear the stress, not you.

Our close involvement with C++ has taught us a lot about your needs as a professional developer, especially when you begin putting Glockenspiel C++ through its paces. No doubt you will test Glockenspiel C++ 2.0 to the limit.

So we do it first.

Our experience - development, training and consultancy and code feedback from hot-line support - has allowed us to build a real world environment in which to stress test Glockenspiel C++ 2.0 for serious users. It works. It's portable. And it's available NOW.

Glockenspiel C++ 2.0 running on: ❒ IBM 6000 ❒ DECsystems ❒ VAX/VMS ❒ VAX Ultrix ❒ Sun ❒ MIPS

❒ DOS & OS/2 (with Glockenspiel CommonView) ❒ 386/ix ❒ SCO UNIX/386 ❒ Intel UNIX Sys V/386 .... and others!

Call your local Glockenspiel distributor or: Glockenspiel Ltd., 39 Lwr. Dominick Street, Dublin 1, Ireland. Phone: (+353 -1) 733166 Fax: (+353 -1) 733034

Circle 436 on Reader Service Card

Add a 650-MB Rewritable Optical Drive to Your Mac

Unlike WORM (write once/read many times) optical drives, the ProOpt 650 lets you erase and rewrite data up to 1 million times, according to Formac. The rewritable optical drive for the Macintosh features a Sony magneto-optic drive mechanism that lets you store up to 650 MB of data on a single removable cartridge and offers an access time of 95 ms.

All Macintosh software works transparently. You can use the ProOpt 650 in combination with a scanner as an archiving system to replace paper- and microfilm-based libraries, or you can use the drive for applications such as sequential backup of large network servers.

ProOpt 650's external dimensions are 25 by 25 by 11 cm, and it weighs 6.5 kg. You connect the unit to your Mac's SCSI connection and use it like a regular hard disk drive.

Price: 12,000 deutsche marks.

Contact: Formac GmbH, Charlottenstrasse 13, D-1000 Berlin 61, West Germany, 49-30-251-04-01.

Inquiry 925.

You can erase and rewrite the data on the ProOpt 650 up to 1 million times.

The Ultimate File Transfer System

The 5:30 system can achieve parallel-port file transfers between IBM PCs at speeds of up to 50K bytes per second. Simple point-and-pick operations let you copy disks, directories, and files without having to set up data transfer rates, port information, or protocols—you just plug in the cable and run the program. In addition, background mode lets you transfer files while you are using your computer, and the Transfer Definition System facilitates repetitive file transfers.

When you have 5:30 running on both machines, you can see the 5:30 screen on your computer. The left window displays a list of the disks, directories, and files on the local computer, as well as information such as the number of files, the size of the files, the size of the disk, and the available space on the disk. The right window displays the same information from the remote computer.

If while you are running 5:30 you need to execute DOS commands or run another program, you can do so without exiting 5:30—the package's DOS shell lets you issue DOS commands normally and then return to 5:30.

On both the local and remote computers, you can delete and rename files and directories. The package also lets you create directories on both the local and remote computers.

You can also use 5:30 through the serial port, in which case you need to connect the two computers with a null-modem serial cable. When you use 5:30 in serial mode, it defaults to 115,200 bps, which is the maximum data transfer rate possible on an IBM PC.

The 5:30 package runs on the IBM PC with 256K bytes of RAM, DOS 2.10, and one parallel printer port; it includes an adapter and cable. It is available in English, French, German, Italian, Spanish, Swedish, Finnish, Danish, and Dutch versions.

Price: £89.

Contact: International Data Security, 37–41 Gower St., London WC1E 6HH, UK, 44-1-436-2244.

Inquiry 902.

If you would like your new product considered for publication in the international section of BYTE, send press releases to BYTE, Attention: Martha Hicks, One Phoenix Mill Lane, Peterborough, NH 03458, U.S.A.; or Dick Pountain, BYTE, McGraw-Hill Publishing Co., 34 Dover St., London W1X 3RA, UK; or Nikkei BYTE, 1-1, Kanda-Ogawamachi, Chiyoda-ku, Tokyo 101, Japan. All press releases must contain price information, address, and telephone number.

A Stationary Mouse

With Sysgration's Agiler Mouse, you can control all the movements of a mouse cursor by moving your finger on a touch-sensitive pad. The stationary mouse also lets you use the movement of your finger to control the resolution—you move your finger slowly for low resolution or quickly for high resolution. In addition, you can execute all commands using the three buttons next to the touchpad.

The Agiler Mouse connects to your IBM PC through the RS-232C serial port and is compatible with existing mouse software. It measures 102 by 72 by 25 mm and weighs 138 grams.

Price: $150 U.S.

Contact: Sysgration Ltd., No. 542-7, Chung Cheng Rd., 8th Floor, Hsin Tien, Taipei 23138, Taiwan R.O.C., 886-2-914-7691.

Inquiry 904.

continued

Add Grabbed Images to Text on a Mac II

Torch Technology's new desktop publishing product, RSVP Publisher, lets you incorporate pictures produced from grabbed images into textual documents. Based on the company's Raster Scan Video Processor (RSVP) board, RSVP Publisher runs on the Mac II.

The product uses a video camera to capture live images, or a frame from a tape running on a video recorder, as input for pictures. You can then manipulate these images in various ways, such as zooming, panning, cropping, and copying, before incorporating them into textual documents. You can use Silicon Beach's Digital Darkroom to perform sophisticated manipulation of RSVP Publisher images. You can export images produced by RSVP Publisher to popular publishing packages such as Aldus PageMaker, QuarkXPress, and Ready-Set-Go.

The on-board TMS320C25 digital signal processor creates and manipulates display lists to control module operations such as frame grabbing, buffer switching, palette manipulation, zooming, and panning. In addition, it controls overlays and keying, as well as providing programmable frame interrupts for synchronization purposes. You can also program the DSP directly for dedicated image processing and other high-performance graphics functions.

The board provides a full 8-bit video input and framestore with software-programmable resolutions that include those meeting the picture requirements of European and U.S. broadcast TV standards. Output lookup tables provide 256-level gray scales or 256 colors from a palette of 16.7 million shades. If you install three cards, the system can output 24-bit true color. Input lookup tables let you perform operations such as thresholding and contrast enhancement at full frame rate. You can mix live video and graphics by utilizing the keying and overlay functions.

RSVP Publisher uses a video camera or VCR to capture images that you can then manipulate before incorporating them into text documents.

The software supplied with the RSVP includes an interface with slot configuration and a dedicated card driver. A C library and associated declaration header files let you access extra driver functions conveniently. To guide you in creating applications that make use of the hardware facilities, Torch has supplied a demonstration program that illustrates the use of the library and QuickDraw.

Other features include NuBus compatibility, four switchable 8-bit video inputs with lookup tables and genlock, and a 448K-byte video DRAM framestore directly addressable from NuBus.

You get functions such as smooth hardware panning in single-pixel increments; ×1, ×2, ×4, or ×8 independent horizontal and vertical hardware zoom; ×1, ×½, ×¼, or ×⅛ horizontal and vertical video input compression, and 15 color overlays.

Price: £1395.

Contact: Torch Technology Ltd., Abberley House, Great Shelford, Cambridge CB2 5LQ, UK, 44-223-841000.

Inquiry 919.

Computer-Aided Environmental Management

Recon helps you monitor coastal or inland waters for pollution and develop an optimum environmental management plan. You enter data on the geometry of the mainland, islands, channels, gates, and inflows and outflows of water and pollution, and, optionally, measurements of currents and the concentration of pollutants in the area. The software then reconstructs the field of currents and the concentration field of a pollutant in a coastal sea, bay, river, or lake.

You can use Recon to obtain the best distribution of a pollutant (in the least-square-error sense) subject to the transport law, to discover unknown pollution sources, and to estimate the extinction rate of the pollutant. After you reconstruct the fields, you can change the data to reflect any potential environmental management plan and then run Recon again to predict how the pollutant distribution will change in the area if the plan is carried out.

Recon requires an IBM XT with 640K bytes of RAM, DOS 3.1, a hard disk drive, a graphics adapter, and an Epson-compatible printer.

Price: $950 U.S.

Contact: Micro Ada, Attn: P. Pecina, Mestni Trg 13, YU-61000 Ljubljana, Yugoslavia, 38-61-224-666.

Inquiry 900.

Bondwell's IBM AT-Compatible Laptop

Weighing just 6.8 kg, Bondwell's battery-powered B300 laptop computer offers IBM AT compatibility, portability, advanced graphics, and extensive memory and processing capabilities.

The B300 comes with a 286 microprocessor, a supertwist LCD screen with a backlit electroluminescent panel, 1 MB of RAM (expandable to 1.5 MB), a 3½-inch 1.44-MB floppy disk drive, and a 20-MB hard disk drive. Other standard features include an 80287 coprocessor socket, a 1200-bps Hayes-compatible modem, an RS-232C serial interface, a parallel RGB interface, a built-in rechargeable battery, an AC power adapter, a real-time clock/calendar, and DOS 3.3 and GWBASIC 3.22 system software.

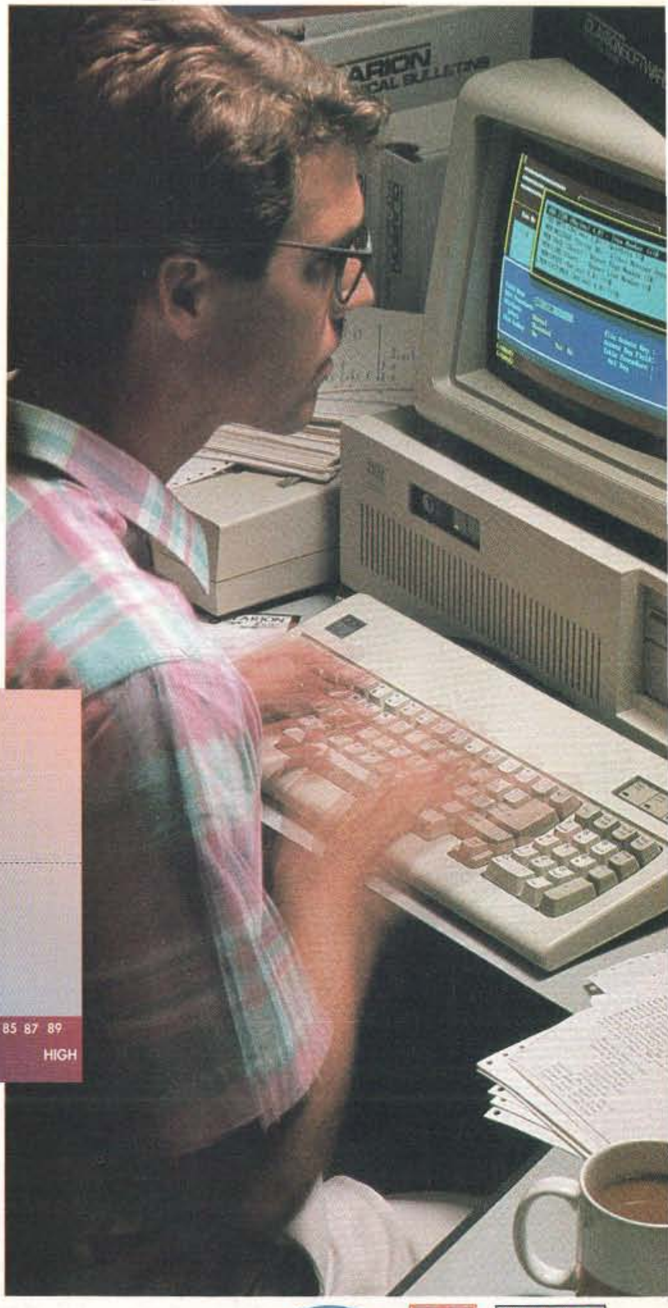
Price: £2199.

Contact: Bondwell (UK) Ltd., Vigilant House, 120 Wilton Rd., London SW1V 1JZ, UK, 44-1-931-8044.

Inquiry 921.

continued

"I Get Paid to Write Programs. And Now, I'm Writing Them Twice As Fast."



If you write programs for a living, get to know The Clarion Professional Developer® 2.1.

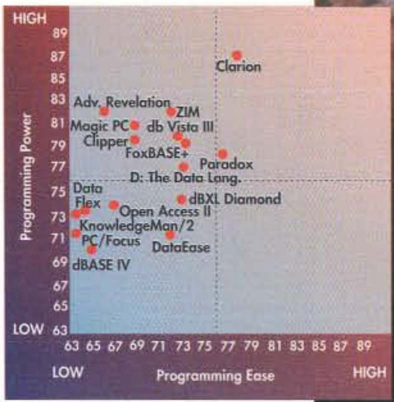
It can cut applications development time by 50% or more without compromising your design. It's so fast and easy, you can complete prototypes while your clients watch.

Professional Developer 2.1 can interface to routines from C and Assembler. It allows import and export of dBASE, BASIC and DIF files. Its application generator produces commented source code which can be easily adapted with its utilities to allow you to generate .EXEs. Network support is included at no extra cost. There are no run-time licenses or fees. And now Version 2.1 includes Report Writer, which allows you to easily and intuitively create ad hoc reports and queries (from Clarion files, non-Clarion files or any combination).

Professional Developer is an immensely powerful, easy-to-use DBMS application developer. We didn't say it: The PC WEEK poll of corporate satisfaction said it. We came out head and shoulders above the 15 other programmable databases. No one else came even close.

In this business where time is money, let Professional Developer help you generate more money for your time. Below is a partial list of our world-wide network of dealers. For the one nearest you, call:

(U.S.A.) 800-354-5444 (Canada) 305-785-4555



Here's what American corporations in a PC Week survey thought of the power and ease of use of Professional Developer vs. competitors. Any questions?

CLARIONSOFTWARE™

150 East Sample Road, Pompano Beach, FL 33064

Clarion Software Products run on any IBM PC, PS/2, or true compatible with 512K of memory and a hard disk. Clarion Professional Developer, is a registered trademark and Clarion Software is a trademark of Clarion Software. Copyright 1989 Clarion Software. dBASE is a registered trademark of Ashton Tate.

AUSTRALIA
Digital Solutions
Level 1, #6, Wighton Street
Margate 4019
PHONE: 61-07-883-1851
FAX: 61-07-283-1217

BENELUX
(THE NETHERLANDS, BELGIUM, LUXEMBOURG)
Advantage Software BV
Utrechtsestraat 70-72
1017 VR Amsterdam
The Netherlands
PHONE: 31-20-26-46-58
FAX: 31-20-22-80-61

ENGLAND (UK)
Dark Star Information Systems
12 St. Peters Court
Middleborough Colchester
Essex CO 1 1WD
PHONE: 44-206-578-224
FAX: 44-206-578-504

FINLAND
Super Systems OY
Karakalliontie 1
02620 Espoo
PHONE: 358-0-509-1043
FAX: 358-0-592-046

FRANCE
Bionix
34, rue de la Saussiere
92100 Boulogne
France
PHONE: 33-1-46-05-74-89
FAX: 33-1-46-05-01-77

NEW ZEALAND
COMTECH
P.O. Box 22-069
Otahuhu, Auckland
New Zealand
PHONE: 64-9-276-6715
FAX: 64-9-276-3499

NORWAY/SWEDEN/DENMARK
ATM Corporation
P.O. Box 28
5045 Skjoldtun
Norway
PHONE: 47-5-137-285
FAX: 47-5-137-260

SOUTHERN AFRICA
Chariot Software (PTY) Ltd.
P.O. Box 283
Steenberg 7947
PHONE: 27-21-728-705
FAX: 27-21-728-702

Circle 416 on Reader Service Card (DEALERS: 417)

EUROPE AND WORLD

High-Specification Computers for Education

Microvitec offers a new range of high-specification IBM PC–compatible computers aimed at secondary schools and higher education. The computers use operating systems and software at performance levels found in commercial environments, which allows students to work with applications such as CAD, desktop publishing, image processing, and molecular modeling, as well as traditional business and educational applications.

The Cub SX features a 16-MHz 386SX 32-bit microprocessor, 1 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, and a 20-MB hard disk drive. In addition, the computer comes with color VGA graphics and a Microvitec 14-inch Series 9 monitor. Other features include a socket for a 16-MHz 80387 coprocessor, DOS 4.01, a real-time clock/calendar, a 101-key keyboard, and EMS 4.0 support. Options include 4 MB of RAM on the motherboard, hard disk drive capacities of up to 175 MB, and a range of high-resolution graphics cards.

The other two computers, the Cub VGA and Cub 286, come with a similar range of specifications. The Cub VGA features an enhanced 8088 microprocessor running at 9.54 MHz, a 3½-inch 1.44-MB floppy disk drive, a 20-MB hard disk drive, and 640K bytes of RAM on-board. Other features include a socket for a 10-MHz 8087 coprocessor, DOS 4.01, a real-time clock/calendar, and a 101-key keyboard. The Cub 286 offers a 286 microprocessor running at 12.5 MHz, 1 MB of RAM, a 3½-inch 1.44-MB floppy disk drive, and a 20-MB hard disk drive. Other features include a 101-key keyboard, a socket for a 12-MHz 80287 coprocessor, DOS 4.01, and a real-time clock/calendar.

All the units come with five full-size expansion slots, RS-232C and Centronics parallel ports, and DOS, GW-BASIC, and menu/utilities software.

The Cub SX and Cub 286 can operate as network file servers; the Cub 286 and Cub VGA can act as network workstations.

Microvitec is supplying two networking system options for the range. Sage MainLAN from Sagesoft is a low-cost entry-level networking solution that enables PCs to talk to each other and share peripherals without the need for a file server. You can network up to 63 workstations with Sage MainLAN.

The company also supplies a high-specification networking solution: Ethernet and NetWare. This lets you network up to 1024 workstations with raw data traveling at a speed of 10 million bps.

Price: £960 to £1700.

Contact: Microvitec plc., Futures Way, Bolling Rd., Bradford, West Yorkshire BD4 7TU, UK, 44-274-390011.

Inquiry 932.

continued

Introducing the affordable PostScript solution for the HP LaserJet IIP

So easy to use—simply plug it in

We've done it again! Pacific Data Products has expanded its family of laser printer enhancement products with *PacificPage/Personal Edition*™—the first PostScript® emulation cartridge for the HP LaserJet® IIP printer.

PacificPage/Personal Edition offers the same impressive features provided by our *PacificPage* cartridge for the LaserJet Series II:

"Users said that PacificPage offers a better combination of reasonable cost and ease of use"
PC Week, *August 7, 1989*

"...produces pages that look strikingly better than those produced by a 300-dpi Adobe PostScript printer"
PC Magazine, *November 28, 1989*

"PacificPage offers the easiest way to get PostScript output from a non-PostScript laser printer...PacificPage is also the most convenient solution because users can print files in one step, without exiting the application...The ability to scale all 35 fonts to any size and the fact that most, if not all, graphics packages have extensive PostScript support are two reasons to buy PacificPage"
PC Week, *November 20, 1989*

1989 BYTE AWARD OF DISTINCTION

PC Computing MVP MOST VALUABLE PRODUCT

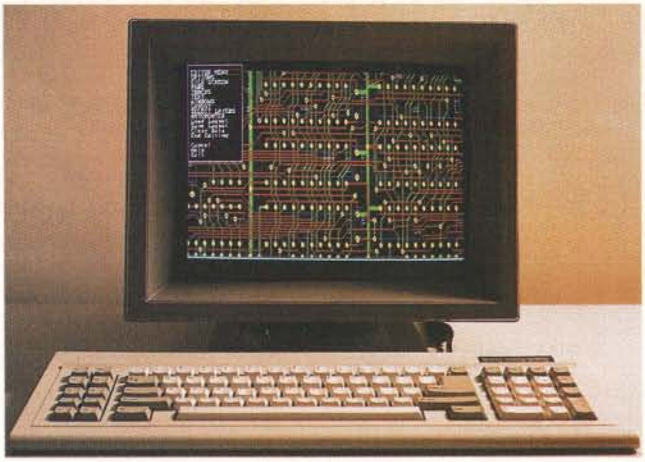
"PacificPage is the easiest to use, highest quality PostScript emulator yet."
PC/Computing

For your nearest authorized dealer, or for more information on our full line of laser printer enhancement products, call:

PACIFIC DATA PRODUCTS
9125 Rehco Road
San Diego, California 92121
Tel (619) 552-0880, Fax (619) 552-0889

PACIFIC DATA EURO LTD
48 Crown Street,
Reading Berkshire RG1 2SE England
Tel (+44) 734 575727, Fax (+44) 734 591594

Circle 465 on Reader Service Card (DEALERS: 466)



With PCB Turbo, you can design printed circuit boards of up to 32 by 32 inches and with up to six layers.

Design and Draft Printed Circuit Boards

You can design printed circuit boards of up to a maximum size of 32 by 32 inches and with up to six layers with version 2 of Instagraphic's PCB Turbo. The design and drafting package for the IBM XT also features an autorouter and a Gerber driver.

The minimum step size is 0.001 inch, and both pads and tracks are user-definable with a minimum width of 0.002 inch and a maximum width of 0.998 inch. In addition, pads can be round, square, or rectangular. Other features include plot optimization, which reduces the time it takes to plot your artwork; improved and extended Gerber photoplotter support; improved file handling; a library with approximately 400 components; and an interactive autorouter with dynamic rubberbanding. You can now place text in up to nine user-definable sizes.

PCB Turbo 2 lets you output to pen plotters, photoplotters, dot-matrix printers, or plot files and input via mouse, trackball, digitizer, or keyboard. You can generate artwork in any scale for topside, bottomside, inner layers, solder mask, silk screen, checkplot, multiplot, drill drawing, and surface-mount device paste mark. The software is as equally suitable for generating circuit diagrams as for printed circuit board layouts.

PCB Turbo 2 runs on the IBM XT with 640K bytes of RAM, DOS 3.2, and EGA.
Price: £695.
Contact: Instagraphic Ltd., Victoria House, Victoria Rd., Eccleshill, Bradford BD2 2DD, UK, 44-274-626027.
Inquiry 907.

Color Thermal-Transfer Printing

Mitsubishi Electric's G370 can print full-bleed A4 printouts at a rate of about 1 ppm. You can use the 300- by 300-dpi color thermal-transfer printer with the IBM PC and Mac II.

The G370 features a standard Centronics parallel interface with a multiplexer attachment that lets up to four computers share the same printer. It also comes with a 1-MB RAM buffer that lets the G370 operate at maximum performance, and an automatic cassette feed that accommodates up to 100 A4 sheets of paper or overhead transparency film. Capable of printing in 256,000 colors, the G370 is supported with drivers for most popular IBM PC and Macintosh graphics packages.

The ColourOut package from Pisa Systems gives the G370 compatibility with virtually all Mac II software. The G370/ColourOut combination produces output comparable in quality to that of all color PostScript devices. Additionally, Mitsubishi supplies optional G370 hardware interfaces for Hewlett-Packard Graphics Language plotter emulation and direct video dumps.

Like other G Series models from Mitsubishi, the G370 uses heat applied to an ink sheet to transfer wax-based inks to paper or to polyester film for overhead projector slides. A three-color ink-sheet roll prints seven solid colors: the three ink colors (cyan, magenta, and yellow) plus red, green, blue, and black. By employing dithering techniques under software control, the G370 can produce 256,000 shades from the seven solid colors provided by its three-color ink sheet.

You can produce black by perfect-register overprinting of all three primary colors, but the G370's color quality can be enhanced if necessary with an optional four-color ink-sheet roll that includes true black. A black-only ink-sheet roll is also available for monochrome output.
Price: £4690.
Contact: Mitsubishi Electric UK Ltd., Electronics Division, Travellers Lane, Hatfield, Hertfordshire AL10 8XB, UK, 44-7072-76100.
Inquiry 950.

Observe a Remote Station's Screen Over a 10Net LAN

With 10Watch from O.K.Soft, you can observe any remote station's screen from any other workstation on a 10Net LAN. Using the network, the program copies the remote screen to the local workstation and displays it on the local station's screen, recognizing display adapter differences and finding the best way to duplicate the remote screen on the local one. For example, 10Watch finds the best black-and-white representation for colors when watching a color screen from a workstation that has a monochrome display.

During a screen-watching session, the local user can send a message that will pop up on the remote user's screen. The remote station can also execute any DOS command entered at the watching station. In addition, the local user can control the screen update rate by varying the delay between updates from 0 to 3 seconds in steps of half a second.

10Watch tells the observed station's user about the start and termination of the observation process by automatically sending an appropriate pop-up message. You can toggle off this feature to allow for anonymous observation sessions and secure selected stations against screen observation.
Price: 79 deutsche marks.
Contact: O.K.Soft, Postfach 945, Posener Strasse 36, 2940 Wilhelmshaven, West Germany, 49-4421-52002.
Inquiry 947.

continued

Communications for Commodore

Kuma Computers has added a communications program to its range of software for the Commodore Amiga. K-Comm 2 combines ease of use with a range of functions such as flexible BBS type requirements, simple terminal emulation, access to Viewdata services such as Prestel, and a software link to the Psion Organiser handheld microcomputer.

You get data transfer rates from 75 to 9600 bps and facilities for sending and receiving text and binary (XMODEM) files and logging files to disk, printer output, a control code filter for the terminal screen and printer, Viewdata (Prestel) emulation mode, Hayes modem support (in addition to dumb modems), programmable function keys, auto-dialing and log-on sequences, and on-screen help.
Price: £29.95.
Contact: Kuma Computers Ltd., 12 Horseshoe Park, Pangbourne, Berkshire RG8 7JW, UK, 44-734-844335.
Inquiry 937.

A Compact Scanner for Small Images

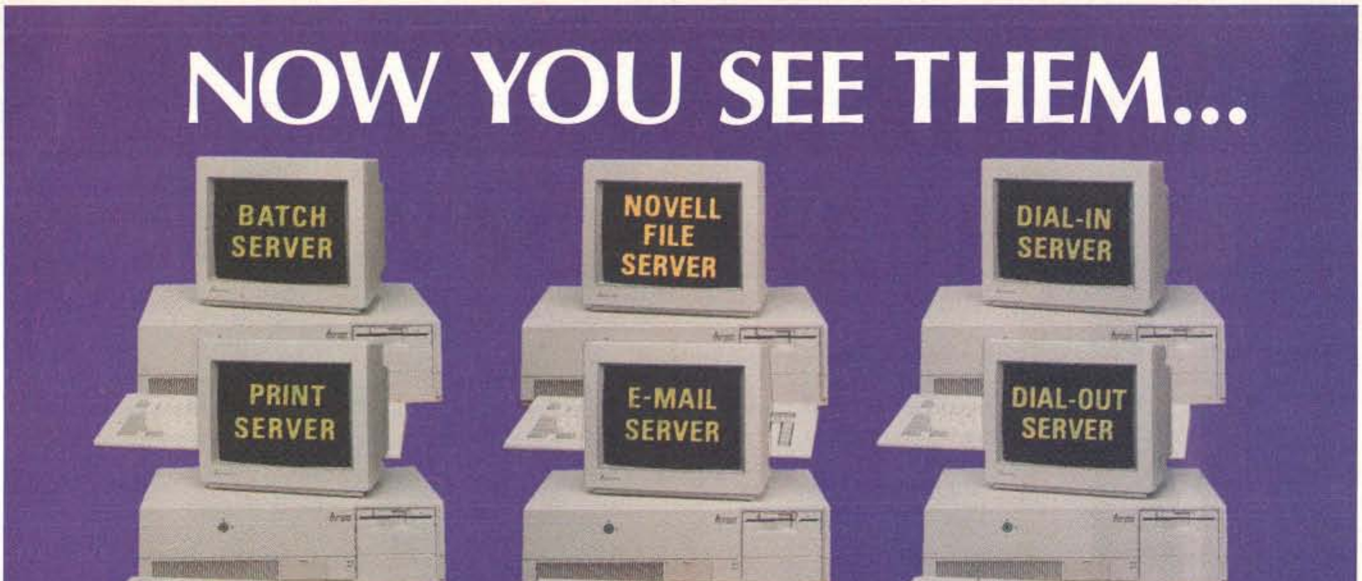
Epson's Handy Color Scanner GT-1000 is designed for scanning small graphics and pictures up to DIN A7 in size. Although the scanner has a compact design (47 by 105 mm), it offers many of the features previously found only on larger scanners, such as the resolution, half-tone recognition, and image manipulation.

To use the GT-1000, you place it on the copy. A viewfinder situated on the top lets you see the surface you want to scan. You can scan in color or in black and white. In color mode, the GT-1000 scans the copy three times using red, green, and blue filters; in black-and-white mode, it scans in a single run. The maximum scanning surface is 74 by 105 mm, and you can set up resolution in steps of 50, 100, and 200 dpi. The data transfer rate is from 2400 to 19,200 bps.

The scanner can differentiate between 256 gray tones, so you can scan very high-quality graphics, according to the company. You can regulate the brightness on a seven-step scale and choose rastering steps for reproduction of grays on printers and monitors. The scanner also features a zoom function and lets you enlarge and reduce pictures from 50 to 200 percent in 10 percent steps.

You get two alternatives for connecting the GT-1000 to a computer: You can use a standard RS-232C (V.24) interface or transfer the data via a bidirectional parallel interface, which requires an additional interface card in the computer. In the second case, the read time for scanning a surface area of 74 by 105 mm in black and white at a resolution of 100 dpi is 30 seconds.
Price: 2238 deutsche marks.
Contact: Epson Deutschland GmbH, Zülpicher Strasse 6, D-4000 Düsseldorf 11, West Germany, 49-211-56-03-0.
Inquiry 959.

continued



DEDICATED SERVER SYSTEMS

Dedicated server systems are a necessary part of today's high-powered LAN. Dedicated servers distribute the power of individual processors to specific LAN tasks. They protect your fileserver from the pitfalls of unexpected crashes, and increase performance by offloading tasks from your main system processor.

A GOOD IDEA—*But look what you'll need:*

- A standalone computer for each dedicated function.
- Extra networking hardware and expensive cabling to connect them together.
- A spare piece of office real estate in which to keep them.
- An explanation why you can't use your expensive computers for anything else.

DEDICATED SERVER BOARDS

QL Series boards—one, two, or four XT- and one or two AT-compatible computers on a card—are elegant replacements for dedicated, standalone machines. They have all the performance and processing power of a computer, but plug into the bus of your fileserver, bridged system, or expansion chassis—out of sight, ready to process tasks on demand.

A BETTER IDEA—*Look what you can do:*

- **ASYNCH DIAL-IN**—With QL boards and communications software, you can dial into network resources from your home or remote office PC.
- **ASYNCH DIAL-OUT**—Dial out using communications software from any network node to bulletin boards, information services, and other networks.
- **DEDICATED FILE SERVICES**—Manage unattended tasks such as message handling for electronic mail, background batch processing, and print queuing.

For better dedicated server solutions, call Cubix Corporation today at 1-800-829-0550

CUBIX CORPORATION

Cubix Corporate Offices • 2800 Lockheed Way, Carson City, Nevada 89706 U.S.A. • Tel (702) 883-7611 • Fax (702) 882-2407
Europe • Unit 4 Colonial Business Park, Watford, Hertfordshire, WD2 4PR, England • Tel (44) 923 51150 • Fax (44) 923 37021

Arity Prolog Bundled with C-Tool/98

Lifeboat's Arity Prolog 5.0 is a Prolog compiler that the company bundles with its C-Tool/98 library. C-Tool/98 is a library for the NEC PC-9801 series that offers graphics, sound, and binary-coded decimal calculations, along with a sample program to call C language functions.

Price: 118,000 yen.
Contact: Lifeboat Inc., 3-6 Kanda-Nisiki-cho, Chiyoda-ku, Tokyo 101, Japan, 81-03-293-4711.
Inquiry 960.

Structural Design Software for the Mac

Graphic Magic claims that Multiframe, its software system for the Macintosh, offers structural designers a working environment that will reduce errors, improve productivity, and result in optimal structural design.

Multiframe's matrix methods provide for analysis of structures ranging from simple span beams to complex high-rise structures. Specialist structural modeling features let you simulate springs, settlement conditions, and variations in structural stiffness, as well as the change in bending moments, shear forces, deflection, or axial forces as you apply loading. Continuous zoom, pan, and shrink commands give you an overall view of a structure's behavior or a detailed examination of critical points.

You model a structure by drawing directly on the screen using Multiframe's drawing tools. A number of overlapping resizable windows let you view and alter the structure and its loading in numerical and graphical form at the same time, with immediate graphical display of any changes to the structure. Multiframe lets you use up to 10 load cases (with factored combinations if necessary), allowing a complete examination of a structure's behavior. Automatic tabulation of weights and quantities also assists in the planning of the project.

Once you have designed a structure, you can store the design and the results of analysis on disk for recall at any time. In this way, you can use stored design histories as a database for future work.

Multiframe's library of structural shapes includes the steel sections commonly used in North America, which you can customize to include nonstandard steel shapes as well as concrete and lumber sections. Other features include graphical specification of restraints, loads, and geometry; functions for rescaling, generating, and duplicating; onscreen preview of printed output; uniform, triangular, or trapezoidal loads; factored combinations of load cases; imperial or metric units; continuous on-screen dimensioning; data transfer to AutoCAD on the Mac or to DOS; and support for color on the Mac II.

Multiframe runs on the Mac 512K or higher, with an Apple ImageWriter or LaserWriter printer.

Price: $1950 Australian.
Contact: Graphic Magic Ltd., P.O. Box 185, Cottesloe 6011, Perth, Western Australia, 61-9-383-2114.
Inquiry 955.

Statistical Software

If you are responsible for managing product or service quality levels or for teaching the statistical aspects of quality control, you may find MiniTab 7.1 useful. You can organize, analyze, and report statistical data using features such as statistical process control (SPC) capabilities, a new command for analyzing general linear models (GLM), descriptive statistics, regression analysis, analysis of variance and covariance, nonparametric tests, tabulation time series analysis, exploratory data analysis, distributions, plots, and histograms.

More than 180 commands work on data that you have stored in a row-by-column worksheet. You can use the commands interactively or store them in command files (macros) for batch processing. Version 7.1 also offers 11 new SPC charts—including X-bar (sample means), R (sample ranges), and P (proportion of nonconformities) charts—that help you measure, monitor, control, and improve process quality. Other features include user-defined titles, footers, and labels for plots and charts; logical operators for setting one value equal to another one (i.e., the Let command); expanded use of alpha data; and nonparametric alternatives to one- and two-way analysis of variance. The software also lets you print high-resolution or character versions of Shewart-type control charts, histograms, scatter plots, time-series plots, and contour plots.

MiniTab 7.1 runs on the IBM PC with 640K bytes of RAM, DOS 2.0, and a hard disk drive. It is also available for DEC VAX computers running VMS and for Prime computers running PRIMOS.

Price: £450 for the DOS version; £250 for academic users.
Contact: CleCom Ltd., The Research Park, Vincent Dr., Edgbaston, Birmingham B15 2SQ, UK, 44-21-471-4199.
Inquiry 901.

A Real-Time Kernel for Concurrent Programming

Terrier gives you multitasking capabilities in a real-time kernel for concurrent programming on an IBM PC and lets you use familiar development tools and debuggers in the development stage. You can perform the programming in Borland Turbo C 1.5, Microsoft C 4.0, Microsoft Macro Assembler, or Turbo Assembler and call Terrier's more than 50 services as you would any standard library functions.

The package gives you fully dynamic task management (up to 64 tasks) with priorities and efficient utilities for message passing, synchronization, and protection. To protect the system resources from collisions caused by several tasks accessing them simultaneously, Terrier provides a queue system, signal/wait, and preemptive locking. The software makes shared data, as in normal C, always available and includes keyboard and text screen routines.

Terrier reserves only 1K byte of stack for each task, and the internal data structures reserve 20K bytes of static data. It runs on the IBM PC with DOS 2.1.

Price: $350 U.S.
Contact: Visilab Oy, P.O. Box 2, 000411 Helsinki, Finland, 358-0-4375-546.
Inquiry 957.

continued

A Joystick Adapter for IBM PS/2s

If you've been looking for a joystick adapter for your IBM PS/2, check out the GameCard III Plus. The multispeed/multisensitive game adapter features an exclusive three-position sensitivity switch and six speed-selection jumpers for improved performance with high-speed computers. You can use the adapter with most games, graphics, and CAD software for the IBM PC, XT, AT, and PS/2s; it supports clock speeds of from 4.77 to 25 MHz.

Price: $79.95 U.S.

Contact: Computer Elektronik Infosys AG, Industriestrasse 42, 8962 Bergdietikon, Switzerland, 41-1-741-3041.

Inquiry 933.

Link IBM PC Spreadsheets to SQL Databases

Henley Business Software offers two versions of a product that links popular IBM PC spreadsheets to sophisticated Structured Query Language databases on standalone PCs, PC LAN database servers, and mainframe databases such as IBM's DB2. You can use SQLVision with Lotus 1-2-3 release 2 and with Microsoft Excel (with Gupta Technologies' SQLBase and IBM's DB2). The two products are the first in a family that lets you transparently link software such as spreadsheets, databases, word processors, and business graphics packages with relational DBMSes using SQL.

SQLVision is designed for users who are not familiar with potentially large databases but who want to access them in order to bring data into their spreadsheets for analysis and reporting. The package is also designed for developers and macro programmers who want to use SQL within spreadsheet macros to build sophisticated multiuser systems around distributed SQL database servers.

The single-user standalone kit includes the SQLBase database and SQLTalk, an interactive database administration tool. The Lotus 1-2-3 version uses the Lotus Add-In Manager, and the SQLBase database software runs in extended memory requiring a 286/386 IBM AT with 1.6 MB of RAM, a hard disk drive, DOS 3.1, and Lotus 1-2-3 release 2.01. SQLVision for Microsoft Excel uses Dynamic Data Exchange to communicate with Excel, and the SQLBase database software runs under Microsoft Windows as a separate task. SQLVision for Excel requires the same hardware as the 1-2-3 version except that it requires 2 MB of RAM together with Windows/286 2.1 or Windows/386 2.1, and Excel 2.1.

For a multiuser system, a NetBIOS-compatible LAN is required together with the SQLBase database server for DOS or OS/2. SQLVision for client workstations is sold in five-user packs. Workstations for the Lotus 1-2-3 version of SQLVision can be 8086 IBM PC compatibles with 640K bytes of memory.

Price: £300 each; £2995 for the first copy of the multiuser system; £2000 for each additional run-time server; £500 for each five-user workstation pack.

Contact: Henley Business Software Ltd., Communications House, Newtown Rd., Henley-on-Thames, Oxfordshire RG9 1HG, UK, 44-491-576466.

Inquiry 931.

continued

ANNOUNCING DAILY NON-STOP DELIVERIES TO EUROPE! AT UNBELIEVABLE PRICES!

LATEST ARRIVALS!

4GL Rapid Develop. Sys. w/Debugger by Informix	$ 1341
Actor for Windows V2.0 by WhiteWater Group	$ 1034
Clipper v5.0 by Nantucket	$ 900
DBXL v1.3 by WordTech Systems	$ 257
DESQview 386 v2.2 by Quarterdeck	$ 229
FoxPro by Fox Software	$ 848
HyperHelp by Hammerly Computer Services	$ 163
HyperPAD by Brightbill-Roberts	$ 157
MathCAD v2.5 by Mathsoft	$ 530
Microsoft BASIC Pro Devel. v7.0 by Microsoft	$ 574
Microsoft Excel-PM for OS/2 by Microsoft	$ 569
Pro-C with Workbench by Vestronix	$ 524
QEMM Expand. Mem. Mgr./386 v5.0 by Quarterdeck	$ 105
QRAM by Quarterdeck	$ 87
Quattro Pro by Borland	$ 579
R&R Report Writer for Oracle ESQL by Concentric Data	$ 364
SCO Open Desktop by Santa Cruz Operations	$ 1159
SCO Portfolio Suite by Santa Cruz Operations	$ 2339
SCO UNIX 386 Devl. Sys. v3.2 by Santa Cruz Oper.	$ 1169
Vermont Views v2.0 by Vermont Creative	$ 599
Xtree Pro Gold by Xtree Company	$ 131

386 PRODUCTS:	Price
386 Max Professional by Qualitas	$ 135
FoxBASE+/386 by Fox Software	$ 541
Microsoft Windows/386 by Microsoft	$ 229
Paradox 386 by Borland	$ 1079
Turbo Assembler and Debugger by Borland	$ 182
VM/386 by IGC	$ 282

ARTIFICIAL INTELLIGENCE:

Arity Combination Pack by Arity Corporation	$ 1319
PC Scheme v3.0 by Texas Instruments	$ 125
PROLOG-2 Programmer by Expert Systems	$ 545
Turbo Prolog by Borland	$ 179
VP Expert by Paperback Software	$ 219

ASSEMBLERS & LINKERS:

Microsoft Macro Assembler by Microsoft	$ 179
Plink86Plus by Polytron	$ 599

BACKUP:

Back-It by Gazelle Systems	$ 119
Backup Express by Digitran	$ 94
Copy II PC v5.0 by Central Point Software	$ 45
FastBack Plus by Fifth Generation	$ 194

BASIC:

Microsoft QuickBASIC by Microsoft	$ 120
ProBas by Hammerly Computer Services	$ 243
Turbo Basic by Borland	$ 115

BUSINESS:

Adobe Illustrator by Adobe Systems	$ 500
FormWorx with Fill and File by FormWorx	$ 157
Gem/3 Presentation Team by Digital Research	$ 505
Grammatic IV by Reference Software	$ 94
GRASP w/Art Tools by Paul Mace Software	$ 208
Harvard Total Project Manager III by Software Pub.	$ 735
Lotus 1-2-3 v3.0 by Lotus	$ 624
Microsoft Excel v2.2 by Microsoft	$ 569
Microsoft Word by Microsoft	$ 419
PFS: Professional Plan by Software Publishing	$ 111
Q&A Write by Symantec	$ 204
SCO Lyrix 386 v6.0 by Santa Cruz Operations	$ 701
SQZ! Plus by Symantec	$ 107
Super Project Expert by Computer Associates	$ 787
TimeLine by Symantec	$ 648
WordPerfect v5.1 by WordPerfect Corp.	$ 451
WordStar Professional by WordStar USA	$ 451
WordStar Spanish by WordStar USA	$ 305

C:

C ASYNCH MANAGER by Blaise Computing	$ 215
C-terp by Gimpel Software	$ 305
C-tree by FairCom	$ 479
Essential Communications v3.0 by Essential Software	$ 400
Greenleaf Communications by Greenleaf Software	$ 322
Microsoft C Compiler v5.1 by Microsoft	$ 515
PC-Lint by Gimpel Software	$ 145
r-tree by FairCom	$ 359
Turbo C Professional by Borland	$ 295
Turbo C Tools by Blaise Computing	$ 184

CADD:

AutoCAD Release 10 by Autodesk	$ 4553
Design CAD 3D by American Small Business	$ 381
DRAFIX CAD ULTRA by Foresight Resources	$ 447
Generic 3-D by Generic Software	$ 355

COBOL:

Microsoft COBOL v3.0 by Microsoft	$ 1033
RM/COBOL-85 Development Sys. by Ryan-McFarland	$ 1413

COMMUNICATIONS:

Carbon Copy Plus v5.2 by Microcom	$ 202
CO/Sessions Complete by Triton Tech.	$ 304
Crosstalk Xvi by DCA/Crosstalk Comm.	$ 181
Mirror III by SoftKlone	$ 95
Procom Plus by Datastorm Technologies	$ 94
Remote2 Complete by DCA/Crosstalk	$ 181
Smartcomm III by Hayes	$ 259
TenNet Plus by DCA/Crosstalk	$ 559

DATABASE & FILE MANAGEMENT:

ALPHA Four by Alpha Software	$ 561
Btrieve by Novell	$ 284
Clarion Professional Developer by Clarion	$ 710
CQL by Machine Independent Software	$ 200
dB_FILE & dB_Retrieve w/Source by Raima	$ 359
dbFast/Plus by Bumble Bee Software	$ 304
FoxBASE+ by Fox Software	$ 361
Omnis Quartz by Blyth Software	$ 857
Paradox v3.0 by Borland	$ 823
R&R Clipper/FoxBASE+ Module by Concentric Data Syst.	$ 65
R:BASE for DOS by Microrim	$ 803
Reflex: The Analyst v2.0 by Borland	$ 284
SQLWindows/Base Single User Dev. Kit by Gupta	$ 1948
XQL by Novell	$ 914

DEBUGGERS:

Multiscope Debugger by Logitech	$ 364
Periscope I v4.1 by PERISCOPE Company	$ 714
Periscope IV 25Mhz by PERISCOPE Company	$ 3379

DESKTOP PUBLISHING:

Halo DPE by Media Cybernetics	$ 223
Page Perfect by IMSI	$ 500
PFS: First Publisher by Software Publishing	$ 145
Publish It ! by TimeWorks	$ 217
Ventura DeskTop Publisher by Xerox	$ 963
Ventura Professional Extension by Xerox	$ 655

DISK/DOS UTILITIES:

Disk Technician Advanced by Prime Solutions	$ 195
MACE Utilities v5.0 by Paul Mace Software	$ 198
Norton Utilities Advanced by P. Norton Comp.	$ 152
OPTune by Gazelle Systems	$ 93
Q-DOS II by Gazelle Systems	$ 67

EDITORS:

Brief v3.0 by Solution Systems	$ 272
Emacs with Source Code by Unipress	$ 869
VEDIT PLUS v3.22 by CompuView	$ 190
VEDIT PLUS for XENIX by CompuView	$ 290

FORTRAN:

ASMUTIL2 & BUTILE by Impulse Engineering	$ 170
Cruise Library by Cruise Scientific	$ 155
GRAFMATIC & PLOTMATIC by Microcompatibles	$ 293
I/O PRO - NO LIMIT by MEF Software	$ 154
Microsoft FORTRAN v5.0 by Microsoft	$ 518
RM/FORTRAN Development Sys. by Ryan-McFarland	$ 675

GRAPHICS:

Designer by Micrografx	$ 761
Essential Graphics v3.0 by Essential Software	$ 460
GSS Graphic Development Toolkit by Graphic Solution	$ 695
HALO '88 by Media Cybernetics	$ 427
Harvard Graphics by Software Publishing	$ 512
PCPaintBrush IV by ZSoft	$ 97
Perspective Junior by Three D Graphics	$ 166
STATGRAPHICS by STSC	$ 990
Vp Graphics by Paperback Software	$ 125
Windows Draw Plus by Micrografx	$ 440

INTEGRATED:

Ability Plus by Migent	$ 258
Framework III by Ashton-Tate	$ 795
Lotus Symphony by Lotus	$ 811
Microsoft Works by Microsoft	$ 175

LAN:

Advanced NetWare 286 by Novell	$ 3115
Btrieve/N by Novell	$ 687
FoxPro Multiuser by Fox Software	$ 1166
Framework III LAN (5 Users) by Ashton-Tate	$ 1135
Harvard Graphics for 5 Users by Software Pub.	$ 1908
Microsoft Word for Network by Microsoft	$ 425
Networker Plus by WordTech Systems	$ 268
Paradox LAN Pack by Borland	$ 1163
Q-DOS II by Gazelle Systems	$ 223
R:BASE for DOS by Microrim	$ 861
Super Project Expert by Computer Associates	$ 787
TimeLine Network Node by Symantec	$ 204
Ventura Network Server by Xerox	$ 1445
WordPerfect - English by WordPerfect	$ 612
WordStar Professional by WordStar USA	$ 514
Xtree Net by Xtree Co.	$ 406

MACINTOSH:

Copy II Mac by Central Point Software	$ 45
Curator by Solutions International	$ 145
DiskFit by SuperMac Technologies	$ 99
FastBack Mac II by Fifth Generation	$ 198
FoxBASE+ by Fox Software	$ 530
FullWrite Professional by Ashton-Tate	$ 452
Generic Cadd-Level 1 by Generic Software	$ 150
Guide 2 by Owl International	$ 337
Hyperworks Organizer by TimeWorks	$ 111
Just Enough Pascal by Symantec	$ 92
LapLink MAC by Travelling Software	$ 210
MacBrain by Neuronics	$ 305
MacFlow by Mainstay Software	$ 188
Macprint by Inside	$ 151
MacSchedule by Mainstay Software	$ 188
Microsoft Word v4.0 by Microsoft	$ 449
OmniPage for Mac by Caere Corp.	$ 970
Omnis 3+ for Tops Network by Blyth Software	$ 995
Pagemaker by Aldus	$ 660
Publish It! by Timeworks	$ 408
Showcase F/X by Aegis	$ 400
SideKick by Borland	$ 121
Smalltalk/V by DigiTalk	$ 245
Symantec Utilities by Symantec	$ 158
Think's Lightspeed C by Symantec	$ 294
Think's Lightspeed Pascal by Symantec	$ 178
ThinkTank by Symantec	$ 200
Turbo Pascal by Borland	$ 126
XTree by Xtree Co.	$ 106

MEMORY RESIDENT PROGRAMS:

DESQview by Quarterdeck	$ 135
Magic Mirror by SoftLogic Solutions	$ 105
SmartKey by Software Research Technologies	$ 67
SoftwareCarousel by SoftLogic Solutions	$ 85
Tornado by Micro Logic	$ 91
Window DOS v3.0 by Window Dos	$ 78

MODULA-2:

EmsStorage with Full Source by PMI	$ 94
Module-2 Development System by Logitech	$ 265
Repertoire/Btrieve Toolkit by PMI	$ 154
Topspeed Modula-2 OS/2 Compiler Kit by JPI	$ 278

OBJECT ORIENTED PROGRAMMING:

Actor for Windows v2.0 by Whitewater Group	$ 1034
Matrix Layout v2.0 by Matrix Software	$ 232
Smalltalk/V 286 by DigiTalk	$ 245
Zortech C++ with Source Code by Zortech	$ 365

OPERATING SYSTEMS:

Concurrent DOS XM 3 Users by Digital Research	$ 306
SCO XENIX 386 Complete v2.3 Unlimited by Santa Cruz	$ 1871
UNIX 386/ix Complete by Interactive	$ 1429

OS/2 PRODUCTS:

Brief Editor by Solution Systems	$ 272
Btrieve by Novell	$ 687
GSS Graphics Devel. Toolkit by Graphic Solutions Sys.	$ 695
Microsoft OS/2 Presentation Mgr. Toolkit by Microsoft	$ 575
Norton Guides by Peter Norton Computing	$ 169
Paradox by Borland	$ 875
Poly AWK by POLYTRON	$ 124
R:BASE by Microrim	$ 990
SCO TCP/IP Development System by Santa Cruz Oper.	$ 467

OTHER LANGUAGES, TOOLS & MISCELLANEOUS:

AskSam by AskSam Systems	$ 306
Guide 2 for PC by Owl International	$ 335
LapLinkIII by Travelling Software	$ 167
Microsoft Mouse with EasyCAD by Microsoft	$ 215
PolyMake by POLYTRON	$ 184
RPG II Development Sys. v3.0 by Lattice	$ 2245
ScanMan Scanner by Logitech	$ 330
Show Partner F/X by Brightbill-Roberts	$ 406
SmarTerm 470 by Persoft	$ 357
SSP/PC Scientific Subroutine Library by Lattice	$ 390
Surfer by Golden Software	$ 604
Tallgrass TG-1100 External Backup by Tallgrass	$ 699
The Complete Hand Scanner by The Complete PC	$ 284
Turbo EMS by Merrill & Bryan	$ 125

PASCAL:

B-Tree Filer by TurboPower Software	$ 155
Pascal ASYNCH MANAGER by Blaise Computing	$ 215
POWER SCREEN by Blaise Computing	$ 184
Turbo Analyst by TurboPower Software	$ 124
Turbo Pascal V5.5 by Borland	$ 176
TurboPASCAL Professional v5.5 by Borland	$ 299
Turbo Professional by TurboPower Software	$ 173

SCREEN DESIGN & WINDOWING:

Flash-Up Developer's Toolbox by Software Bottling	$ 102
Greenleaf DataWindows w/Source by Greenleaf	$ 424
Microsoft Windows Development Kit by Microsoft	$ 585
Microsoft Windows/286 by Microsoft	$ 120
PANEL Plus II by Roundhill	$ 505

TRANSLATORS:

BAS_PAS Commercial by GoToLess Conversion	$ 341
BAS_C Commercial by GoToLess Conversion	$ 455
dBx dBASE to C v4.6 by Desktop AI	$ 905
FOR_C w/Runtime Source by Cobalt Blue	$ 1055

UNIX/XENIX PRODUCTS:

4GL Rapid Develop. Sys. w/Debugger by Informix	$ 2439
BAS_C Comm. for SCO XENIX/386 by GoToLess	$ 563
Microsoft FORTRAN Compiler-XENIX/286 by Micro.	$ 811
Microsoft Pascal Compiler-XENIX/286 by Microsoft	$ 811
Microsoft Word for XENIX by Microsoft	$ 701
RM/COBOL Dev. Sys.-UNIX/XENIX 286 by Ryan-McF.	$ 2144

USA SOFTWARE

LIMMATQUAI 116 • 8001 ZURICH, SWITZERLAND

PHONE: (01) 252-6710 FAX: (01) 252-7795 TELEX: 814460

(Attn: USA SOFTWARE)

All major credit cards accepted. Thirty (30) day billing for qualified organizations.

Special discounts for large or corporate buyers. All prices in US dollars.

Add shipping charge from Zurich at prevailing rates.

Prices subject to change without notice.

Hours: 8:30 AM - 5:30 PM.

BO490

Over 2,500 products carried. Call today for price list-disk.

Circle 327 on Reader Service Card

Manage Your Photography Business

Whether you are a freelance or professional photographer, Gofer can help you manage your picture library of up to 250,000 photographs.

The freelance package labels photos as you log them into the system. You can also enter information about potential clients and individual details of a particular job submission. In addition, Gofer lets you print out a delivery note containing relevant details, such as fees and rights, to accompany a job. By simply pressing a key, you can also see what material is with which client and when it is due back. Finally, as pictures come back, Gofer lets you reenter them into the library and list the ones that are still outstanding.

To the features of the freelance package, the professional package adds a mailshot labeling facility that helps you estimate jobs and then print out estimates and invoices. It provides a cross-reference search facility and lets you control due-back dates, print overdue notices, and invoice holding fees.

The top-of-the-range Gofer, the library package, has all the features of the other two packages plus a module that provides entries for contributors with listings of picture submissions and sales. It lets libraries supply statements of sales as well as lists of pictures held in stock.

Gofer runs on the IBM PC with 640K bytes of RAM, DOS 2.0, and a hard disk drive.

Price: £325 for the freelance package; £459 for the professional package; £595 for the library package.

Contact: Lupe Cunha Photos, 45-47 Clerkenwell Rd., London EC1M 2RS, UK, 44-1-251-5950.

Inquiry 905.

An IBM PC Monitor with Superhigh Resolution and Color

Tatung offers the CM 1495G, a 14-inch superhigh-resolution multisynchronous color monitor for the IBM PC. The monitor has an automatic horizontal scanning frequency of from 15 kHz to 35 kHz and a vertical scanning frequency of from 47 Hz to 73 Hz under VGA.

The high-contrast, antiglare, dark-tinted CRT can display four colors with sequential soft-key switching for normal, green, amber, or white-on-blue displays at a resolution of 800 by 600 pixels or 1024 by 768 pixels (interlaced).

The CM 1495G is a compact unit measuring 365 by 315 by 377 mm. It comes on a tilt-and-swivel base and weighs 17 kg.

Price: £549.

Contact: Tatung (UK) Ltd., Stafford Park #10, Telford, Shropshire TF3 3AB, UK, 44-952-290111.

Inquiry 928.

continued

USE YOUR FAX TO FIND THE LOWEST COMPUTER PRICES IN THE WORLD

When you know exactly what you want, the last thing in the world you need is a salesman.

Once you've come to a thoughtful decision on components, systems and peripherals or software, all you want to know is "how soon can I get it."

...and you want the facts "now!"

That is why we formed Elex International five years ago. We don't want to sell you a thing. We do want to help you find exactly what you need at a price you are happy to pay.

Very often, we find what you want in the very last place you might expect: in the USA.

Unrestricted competition in the United States keeps prices low and availability high.

Of course, many of the same powerful systems, software programs and components are available to some extent throughout the world, but multi-tiered international distribution channels can inflate prices well above comparable levels we find in the US.

So, whether you are looking for anything from a single 41256 memory chip, to a fully configured IBM AS400 minicomputer system, Elex International gives you an important new purchasing option.

We provide this service to end users, value added resellers and original equipment manufactures throughout the free world.

Wherever you are—in Europe, Africa or Asia—you can get direct access to the low prices and wide range of choices available in the US, right now.

It's easy to test the Elex solution. Fax your system requirements, detailing all appropiate specifications, to an Elex order center. We will respond with a firm bid within the span of a single business day.

Fax any requirements written in English directly to our US Order Center for immediate response.

Requirements written in French, German, Spanish Italian or Russian should be Faxed to our Order Center in Geneva.

If you don't need an immediate quote, feel free to call or write at any of our Order Centers.

However you choose to contact us, you will gain an important new source that is committed to filling your computer system requirements promptly and at prices your local distributor cannot match.

Payment Method: L/C, T/T, VISA, COD

Elex International, Inc.

136 North 3rd St.
Philadelphia, PA 19106, USA
Telephone: 215-627-1691
Toll-free Orders: 800-783-2313
FAX: 215-627-2342

Elex Information Systems, SA

16 Rue du Simplon
1207 Geneva, Switzerland
Telephone: 41 22 7864971
24-hour Elex Net Modem 41 22 7357280
FAX: 41 22 7357669

France—FAX 33 50 921519 UK—FAX 441 581 98 14

A Printer-Sharing Device Built for Two

Two users can share one printer with the Simple-2-Switch, a dual-mode device that the maker claims is as simple to operate as standard mechanical T-switches. The device comes with serial or parallel interfaces, and you can use it with laser printers or plotters.

Simple-2-Switch allows automatic or manual switching between users—an indicator light shows which user is connected to the printer. When you switch it on, the device goes into automatic mode and locks onto whichever input is receiving data. The switch knows when the printer or plotter is free, giving the second user immediate access. In manual mode, you use a simple switch on the front of the device to control it.

The Simple-2-Switch has adjustable time-out periods, which control how long the automatic switch waits before allowing the other computer to send data. The parallel model lets you issue form-feeds automatically between users.

Price: £79.

Contact: Micro Control Systems, Electron House, Bridge St., Sandiacre, Nottingham NG10 5BA, UK, 44-602-391204.

Inquiry 938.

Simple-2-Switch lets two users share one printer.

Premium PCs

AST offers the Premium 386SX/16, an entry-level 16-MHz 386SX-based system equipped with cache memory for zero-wait-state performance, which also includes the AST Cupid-32 (for Completely Universal Processor, I/O Design) upgrade path to Intel's i486 technology.

The system uses 32-bit processing and features five expansion slots, five half-height disk drive bays, a 16-bit AST VGA adapter, 1 MB of memory (expandable to 4 MB on the processor board and to a total system maximum of 16 MB), two serial ports, and one parallel port.

Three models are available that differ in the type of floppy disk drive and amount of hard disk drive storage capacity. The Model 3V has a 3½-inch floppy disk drive, the Model 5V has a 5¼-inch floppy disk drive, and the Model 45V has a 5¼-inch floppy disk drive and a 40-MB hard disk drive. All three models run under DOS, OS/2, Xenix, or Unix.

The latest addition to AST's range of upgradable Cupid-32-architecture systems, the AST Premium 486/25, uses a 25-MHz i486 microprocessor with 8K bytes of cache and an 80387-compatible numeric processor integrated onto the chip. The machine also supports the Weitek 4167 coprocessor, and its burst-mode operation speeds data transfer between memory and cache.

The Premium 486/25 comes with 2 MB of zero-wait-state memory, expandable to 4 MB on the processor board and to a total of 36 MB for the system. The system offers seven expansion slots, five storage bays, controller support for three floppy disk drives, one parallel port, and two serial ports.

Three configurations are available: the Model 5, with a 5¼-inch floppy disk drive; the Model 115, with a 5¼-inch floppy disk drive and a 110-MB hard disk drive; and the Model 325, with a 5¼-inch floppy disk drive and a 320-MB hard disk drive with an ESDI controller.

Price: £1895 each for the Premium 386SX/16 Model 3V and Model 5V; £2595 for the Model 45V; £7395 for the Premium 486/25 Model 5; £8595 for the Model 115; £10,395 for the Model 325.

Contact: AST Europe Ltd., AST House, 2 Goat Wharf, Brentford, Middlesex TW8 0BA, UK, 44-1-568-4350.

Inquiry 945.

A System for Developing Parallel Applications

If you would like to develop high-performance, hardware-independent parallel applications, write parallel code using conventional high-level languages, and create easily maintainable and portable software, then Meiko's In-Sun Computing Surface may interest you. The product family integrates a networked multiuser window-based interface, Unix, and the computational performance of a parallel machine and supports industry-standard programming languages, debuggers, support utilities, and other productivity tools.

The In-Sun Computing Surface is a scalable, multiprocessor, distributed memory architecture. Individual processors execute sequential threads of an application program and exchange information via interprocessor message links. You can use the processors independently for sequential applications or in groups for parallel applications. The boards have from one to four T800 transputers that manage the interface between individual application processors and the host environment. These interface processors have a shared memory system of up to 4 MB of multiported RAM, of which 1 MB is dual-ported to the VMEbus. The operation of the interface is entirely transparent, supporting data transfer rates of 2.2 megabytes per second to the Sun filing system and Sun-hosted application front ends.

The Message Link Switch allows you to establish high-speed, low-latency message paths between the Sun environment and all the individual application processors anywhere within the Computing Surface (i.e., processors on the same board, on other boards within the Sun chassis, or within an attached Computing Surface module). Message paths through the switch all operate at 20 megabits per second simultaneously. The Link Highway is the means by which the Message Link Switch extends transparently across board edges. It is entirely enclosed within the electrical environment and chassis of the host machine.

continued

BEST BUY

"So simple to use you wonder why other packages make such a meal of resource allocation."

PC MAGAZINE

"InstaPlan offers the features of a £2,000 package with none of the trade offs of its low cost competitors."

PERSONAL COMPUTER WORLD EDITOR'S CHOICE

"We would recommend most warmly... InstaPlan as the best full featured project management package."

Practical Computing

(compared with PMW, Super Project and Harvard).

"InstaPlan is excellent, much better value than PMW, but keep improving it" Mr D Symington, CS Consultants

NEW InstaPlan 5000

InstaPlan 5000 is the latest addition to the InstaPlan family of project management software, which already has 25,000 users, from large multinationals to one man businesses, and is fully compatible with the rest of the InstaPlan family.

Easier Departmental Management

InstaPlan 5000 can gather individual project plans and consolidate them for departmental review, all with a single command on a stand alone machine or a PC network.

By bringing together the department's schedules and resource requirements in one model, you can recognise and resolve staffing conflicts and project priorities long before they become crises.

Most project management systems require all projects to be updated to the same date before merging. This is often impossible. InstaPlan 5000 allows projects to be combined freely.

Planning and Control for Larger Projects

InstaPlan 5000 will run on a standard 640K PC, Just like the rest of the InstaPlan family. But InstaPlan 5000 also supports EMS (Expanded Memory). This means that you can handle in excess of 10,000 Activities. Within these limits you are only constrained by the amount of EMS memory you have available. This is many times the capacity of some of InstaPlan's more expensive competitors.

Better Resource Management

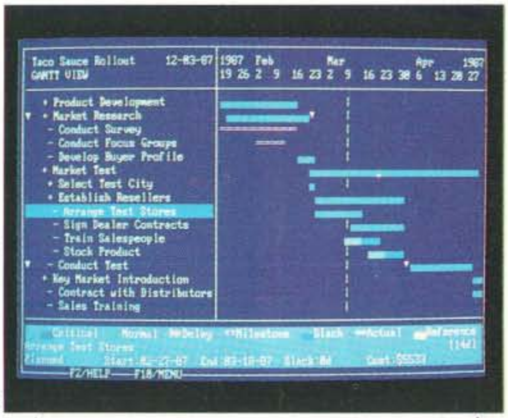
You can now level the load on a group of resources simultaneously, using he Adjust Loading command. The Locate Overload facility will scan all future periods for a resource, identifying any overloads.

We believe InstaPlan 5000 will provide the best solution for professional project managers and busy line managers who need project management to enhance their own and their department's performance.

See what InstaPlan users say:-

Easy to learn and Use

...it's design is just right. I set up a workload plan without even using the manual or any previous planning experience.
David Allen — *Computer Services Manager*
Vallectric Ltd — *Electrical Contractors*



With Quality Documentation

...a very good package, with excellent documentation.
Mr J Clarke — *Finance Director*
Ceraf Ltd — *Building Contractors*

...And Support too

...Good telephone support
Dr Robin Wilson
Harrogate Borough Council

Providing the Right Reports

...provides me with succinct and easy to understand documentation for Board presentations.
Dr R Gailey — *Director of Research*
Tootal Thread Ltd

For Line Managers

Even though our busy line managers are only occasional users, InstaPlan gives them the tools to plan quickly and effectively.
Brian Alldridge — *MIS Manager*
Prestwich Holdings plc

and for Project Managers

I am surprised to find myself learning from this product – an excellent investment.
Mr P M Cleary — *Project Manager*
Maritime Dynamics Ltd

compared with the competition

Having suffered with Project Manager Workbench and SuperProject Expert, InstaPlan has provided us with the tools to produce all our reports and regular project updates easily. Management are impressed by the ease with which they can read and understand the reports.
Ms Petra Meyer — *Product Manager*
Travicom Ltd

In summary

InstaPlan contains all the features and facilities required for project tasking, costing and tracking. An excellent, good value package, it forms the basis of successful project management within a business environment.
Andy Coster — QA Manager,
Logsys

Money Back Guarantee

We are confident InstaPlan 5000 is the easiest project management system to learn and use, offering a significant price/performance advantage over all other systems. Buy InstaPlan 5000 now, if you return it within 30 days for whatever reason, we guarantee to refund your money by return.

DEEPAK SAREEN ASSOCIATES

Freepost, 28 Preston Rd, Wembley HA9 8BR
Phone 01 908 2423 Fax 01 904 6668

InstaPlan 5000 £499 plus £6 p&p and VAT

☐ **Please send me InstaPlan 5000.**

☐ I enclose a cheque for £580.75

☐ Please bill my Visa/Access Card

☐ **send me more details of InstaPlan 5000 and the InstaPlan family, from only £99.**

Company ....

Name ....

Signature ....

Phone no. ....

Please enclose a compliments slip showing your required delivery address and credit card details if appropriate. PCM/3/90

Configuration: IBM XT AT PS/2 or compatible running under PC MS-DOS 2.1 or later with at least 500K of DOS memory and 3M of hard disk available to InstaPlan. Plan storage requires further DOS memory or access to EMS memory. EMS memory (LIM3.2+) supported to a maximum of 8Meg. A 5000 activity plan will require at least 2 Meg of expanded memory. InstaPlan 5000 will therefore run across networks using network shells like Novell where there is sufficient DOS memory available to InstaPlan. Printers: IBM ProPrinter & Graphics Printer, Epson FX/LX/LQ, Toshiba 351, HP LaserJet PLUS/Series II/Deskjet. Input via keyboard, ASCII, ThinkTank or READY! Output to ASCII, Lotus or dBase. Charts are stored as bit mapped graphics and can be printed but not viewed on screen. ALL MARKS ACKNOWLEDGED. DEALER ENQUIRIES WELCOME. QUANTITY DISCOUNTS AND SITE LICENCES AVAILABLE. TRAINING AND CONSULTANCY AVAILABLE IF REQUIRED.

Circle 427 on Reader Service Card

The System Supervisor is a global communications bus that operates independently of the interprocessor message-passing architecture. It lets you monitor and report run-time and memory-system errors and gives you a dedicated independent path for diagnostics and symbolic debugging. You can reset and reload selected groups of individual application processors without disturbing the rest of the community.

Sun-VCS (Virtual Computing Surface) provides the resource management and physical interface control software. It combines the flexible capabilities of the In-Sun Computing Surface integrated with the SunOS environment. Sun-VCS transparently reconfigures the hardware, establishing the appropriate topologies demanded by parallel applications as they are loaded for execution.

Price: £12,000 to £40,000.
Contact: Meiko Ltd., 650 Aztec West, Bristol BS12 4SD, UK, 44-454-616171.
Inquiry 912.

Upgrade Your Premium 386

AST Europe offers an ISA-based i486 CPU upgrade, called the Fastboard 486/25, that is compatible with all models of its 25- and 33-MHz Premium 386 desktop computer systems. The company also offers a 33-MHz Intel 386 upgrade, called the Fastboard 386/33, for its Premium 386/25 systems.

The i486 chip adds mainframe power to sophisticated personal computer applications such as CAD/CAE, medical imaging, geophysical simulation, and aerodynamic stress testing. In a network environment or multiuser system, the i486 can support large LANs and complex operations running under the Unix/Xenix operating systems and multiuser/multitasking applications.

The 25-MHz chip contains a built-in numeric coprocessor unit and cache memory and is compatible with software written for Intel's 286, 386, and 8088/8086 microprocessors.

AST says that its Fastboard 386/33 is the first 33-MHz upgrade product for 25-MHz personal computers. The 33-MHz Intel 386 microprocessor offers a 33 percent performance boost over the 25-MHz 386.

Price: £2125 for the Fastboard 486/25 upgrade for the Premium 386/33; £2595 for the Fastboard 486/25 upgrade for the Premium 386/25; £1695 for the Fastboard 386/33 upgrade for the Premium 386/25.
Contact: AST Europe Ltd., AST House, 2 Goat Wharf, Brentford, Middlesex TW8 0BA, UK, 44-1-568-4350.
Inquiry 946.

Toshiba's Battery-Drive 386SX Laptop

Toshiba's battery-drive T3100SX 386SX laptop comes with 1 MB of main memory (maximum 13 MB), a VGA-compatible plasma display with 16 tones and a contrast ratio of 100 to 1, and a 40-MB hard disk drive. The computer weighs about 6.8 kg. Internal nickel-cadmium batteries can run the system for about 3 hours.

Price: $5999 U.S.
Contact: Toshiba, Toshiba Building, 1-1-1 Sibaura, Minato-ku, Tokyo 105, Japan, 81-03-457-4511.
Inquiry 953.

continued

£6849

SFT Netware v2.15
Fault tolerant, up to 100 users,
Can also connect to Apple PCs.

PLUS

Elonex 386V-330 File-server,
33MHz, 4MB RAM, **300MB hard disk**,
Intelligent Ethernet server card.

£4379

Advanced Netware v2.15
Up to 100 users,
Can also connect to Apple PCs.

PLUS

Elonex 386S-200 File-server,
20MHz, 4MB RAM, **150MB hard disk**,
Intelligent Ethernet server card.

£2703

ELS-II Netware v2.12
Entry level, up to 8 users,

PLUS

Elonex 386S-200 File-server,
20MHz, 2MB RAM, **72MB hard disk**,
16-bit Ethernet card.

£1977

ELS-I Netware v2.0a
Entry level, up to 4 users,

PLUS

Elonex 386SX-160 File-server,
16MHz, 2MB RAM, **40MB hard disk**,
Ethernet card.

£625

PC Workstation
with Ethernet card and boot ROM

Prices are for sample configurations and are exclusive of VAT.

Your networking headaches taken care of.

As a leading supplier of IBM-compatible PCs, we have gained a solid reputation for service and technical back-up.

As a NOVELL OEM, we can help you take the pain out of choosing the right configuration that meets both your present and future requirements.

Whether you're equipping a small office or large department, you can be confident of getting the best hardware and software solutions, at prices others can only envy.

IBM, NOVELL Netware and APPLE are registered trademarks.

LONDON OFFICE
Elonex plc, Rays House, North Circular Road, near Hanger Lane, London NW10 7XB
Fax: 01-965 3246
Tel: 01-965 3225

NORTHERN OFFICE
Elonex plc, 7-9 Campus Road, Bradford Science Park, Bradford, West Yorkshire BD7 1HR
Fax: (0274) 307294
Tel: (0274) 307226

NOVELL
ELONEX

Please send me information about the Elonex product range and services

NV/BYTE/04/90

NAME

COMPANY NAME

POSITION

ADDRESS

TELEPHONE

Multiport Adapter Cards

The Technology Concepts Ltd. (TCL) PCC/48 intelligent I/O subsystem (a front-end processor) is a modular multiport adapter card that supports 8, 16, 24, 32, or 48 V.24/RS-232C ports. With its 10-MHz 186 CPU and up to 1 MB of dual-ported RAM, it offloads I/O processing from the main CPU and does not clash with other adapter cards, including COM1 and COM2. You can install multiple cards in one machine, and the card offers options for modem handling and virtual consoles.

The multiport adapter card is compatible with standard Xenix-386 drivers for the IBM PC. Technology Concepts provides an installation disk for adding the driver software to your operating system and a utility that enables the 15-byte buffered mode on the adapter.

TCL has also added a new multiport card to its range of serial I/O products. The 8+DB card supports eight asynchronous V.24/RS-232C channels on the IBM AT (ISA) and PS/2 (Micro Channel architecture). It is compatible with industry standards for multiuser systems with configurable interrupt and I/O addresses; the Micro Channel card is software controlled to full IBM standard.

The card lets you buffer up to 16 characters, in and out, per channel, to avoid character loss. In addition, you can daisy chain the interrupt so that you can install multiple cards in one chassis using only one interrupt.

The 8+DB card is compatible with Xenix-286, Xenix-386, AIX, Concurrent DOS-XM, and Concurrent DOS-386. Drivers for DOS and OS/2 are included to extend COM1 and COM2 software interfaces.

Price: £1075 for the PCC/48 card; £525 for the 8+DB card.
Contact: Technology Concepts Ltd., Raglan House, Llantarnam Park, Cwmbran, Gwent NP44 3AX, UK, 44-6333-72611.
Inquiry 930.

High-Performance Network Servers

Memorex Telex has expanded its LAN product portfolio with the 7070, a high-performance network server designed specifically for Novell NetWare and IBM PC LAN users.

The new server is based on a 386 microprocessor operating at 20 MHz with zero wait states, and you can configure it with a variety of high-capacity hard disk drives with ESDI controllers. You can mix and match two 94-, 150-, or 338-MB disk drives on the same server.

The basic 7070 unit features 2 MB of 80-ns RAM, a 200-W power supply, a 3½-inch 1.44-MB floppy disk drive, and four additional 5¼-inch half-height disk drive bays. The RAM is expandable to 16 MB through the addition of 2 MB to the motherboard and the installation of a memory-expansion board using the system's 32-bit expansion slot.

The system, which can be desktop or floor-mounted, offers seven expansion slots (five 16-bit and two 8-bit) and supports a range of network interface cards.
Price: £4995 to £9990.
Contact: Memorex Telex (UK) Ltd., Customer Support Centre, Eskdale Rd., Winnersh, Wokingham, Berkshire RG11 5TS, UK, 44-734-441544.
Inquiry 908.

continued

SHEBRO IBM Compatible Computers assembled by a highhly experienced team of top quality engineers since mid '87 in USA now introduces ***RACER*** series for the nineties.

RACER 286 & 386SX

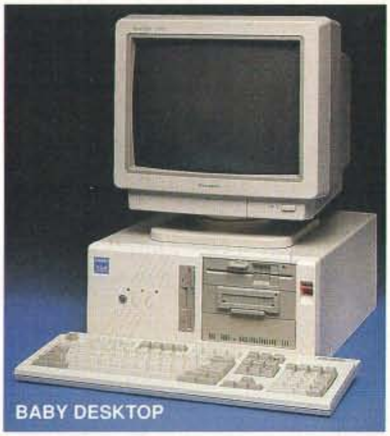
BASIC FEATURES OF *RACER* 286 SYSTEMS: INTEL 80286-12 MHz CPU (Landmark 15 MHz on 0 wait) • AMI-BIOS with built-in Setup & Diagnostic • 1mb RAM expandable to 4mb (8mb on 16 MHz & 386sx) on 4-layer Motherboard • 0 or 1 wait state setting • 8 expansion slots Realtime Clock/Calendar • 1 Parallel, 2 Serial & Game I/O • Math Co-Processor socket(s) • 101 Enhanced Keyboard • 200 watts • Power Supply Barebone Systems include Motherboard with manual, Case/PS & 1mb RAM only, nothing else.

Page Interleave & Shadow RAM support within BIOS on 286-16MHz & 386sx Systems

***RACER* ATM BAREBONE** Motherboard, 1mb RAM, Case & Power Supply only .... $ 445
***RACER* AT-JUNIOR** 1.2mb FD • 30mb-40ms Hard Drive • 12" Amber Monitor $1045
***RACER* AT-SENIOR** 1.2mb FD • 68mb-24ms Hard Drive • 14" DF Amber Monitor......... $1245
***RACER* AT-PRO** As above with 14" EGA Monitor 800x600 Res. Controller.................. $1545
***RACER* AT-SUPER** As above with 14" Super VGA 1024x768 Res. Monitor Controller ... $1645

UPGRADE ON ANY OF THE ABOVE SYSTEMS

with 286-16 MHz Motherboard ....add $180
with 386sx-16 MHz Motherboard ....add $250
Additional 1.2 or 1.44 Floppy Drive ....add ....$ 85


BABY DESKTOP

RACER 386 SYSTEMS

BASIC FEATURES OF *RACER* 386 SYSTEMS: INTEL 80386-25 MHz CPU (Landmark 34 MHz on 0 wait) • AMI-BIOS with built-in Setup & Diagnostic • 1mb RAM expandable to 8mb on 6-layer Motherboard + 8mb on 32-bit Card • 0 or 1 wait state setting • 8 expansion slots Realtime Clock/Calendar • 1 Parallel, 2 Serial & Game I/O • Math Co-Processor socket • 101 Enhanced Keyboard • 200 watts • Power Supply (220W/33MHz) Barebone Systems include Motherboard with manual, Case/PS & 1mb RAM only, nothing else.

Page Interleave & Shadow RAM support within BIOS on systems

***RACER* 386 BAREBONE** Motherboard, 1mb RAM, Case & Power Supply only............ $ 995
***RACER* SOLO 386-25/68** 1.2mb FD • 68mb-24ms Hard Drive • 14" Amber Monitor $1840
***RACER* GURU 386-25/68** As above with 14" EGA Monitor 800x600 Res. Controller...... $2140
***RACER* GRAND 386-25/68** As above with 14" Super VGA 1024x768 Res. Monitor Controller $2240

UPGRADE ON ANY OF THE ABOVE SYSTEMS

****INTEL 82385 Cache** Controller chip and 32k SRAM integrated on Motherboard ....add .... $ 700
****INTEL 80386-33MHz CPU** (Landmark 64 MHz) Motherboard with Cache Controller and32k SRAM ......add $1300


MINI TOWER


TEENY DESKTOP

RACER 486-25 MHz TURBO LANDMARK 114 MHz

$4630

BASIC FEATURES:
INTEL 80486-25 MHz CPU incorporated with 8k Cache Memory, 80387 Math Coprocessor, 82385 Cache Controller (Landmark 114 MHz on 0 wait state) • 2mb RAM expandable to 8mb on 8-layer Motherboard + 8mb on 32-bit Card • 1024x768-512k VGA Controller with 512k 1 Parallel, 2 Serial • 250 watts Power Supply with 8 drive DC outlets, 2 Fans in Heavy Duty Steel Case with wheels, 5 open bays + space for 6 more 5.25" H/H Drives and 16 serial port holes, Front dust cover swing open/close door 1.2mb 5.25" Floppy Drive with MFM or RLL Controller for 2nd any capacity Floppy & 2 Hard Drives • 101 Enhanced High Quality Keytronics Keyboard.

AND WE LET YOU CHOOSE ANY CASE


MIDI TOWER

All Systems Fully IBM Compatible. Operates under DOS/Unix/Xenix/OS2 Novell & other Net-woking Environments (IBM/Lotus-123 & Dbase-III are registered marks of other Corporations).

FREE WITH EVERY SYSTEM

Each system comes with Software packages that include DOS 3.3 or 4.01, DOS Help, Tutorial, Word Processor, Spreadsheet (like Lotus 123) Data Base (like Dbase-III) Communications, Graphics, Desk Top Organizer (Memo Pad, Do-List, Address Book, Dialer, Labels, World Clock)

ONE YEAR FULL PARTS & TWO YEAR LABOR WARRANTY ON EVERY *RACER* UNIT


JUMBO TOWER


BIGGY TOWER

Call 818-912-2233

Pacific Time
8:00 am - 6:00 pm
MON. - FRI.
10:00 am - 3:00 pm
SATURDAY

SHEBRO COMPUTERS, INC.
18025 E. Gale Avenue • City of Industry, Ca 91748
FAX: 818-912-5017 • INFORMATION: 818-912-2233

Circle 473 on Reader Service Card (DEALERS: 474)

SCO Xenix V/386 for the Amstrad 2386

SCO Xenix System V/386 is now available for the Amstrad 2386 computer, the company's 386-based personal computer that comes with 4 MB of memory.

Engineers from The Santa Cruz Operation and Amstrad worked together to ensure that software written for SCO Xenix System V/386 is compatible with the Amstrad. In addition, extra software is provided for the operating system so that it takes advantage of the computer's advanced memory management capabilities.

Price: £650 for SCO Xenix System V/386; £1999 for the Amstrad 2386.
Contact: The Santa Cruz Operation, Croxley Centre, Hatters Lane, Watford WD1 8YN, UK, 44-923-816344.
Inquiry 929.

High-Performance Graphics on an AT Compatible

Designed for high-performance graphics work, the SideCar 386 is a 386-based IBM AT compatible housed in a compact tower that's 13¼ inches high and 7 inches wide.

You can use the SideCar 386 as a stand-alone computer or with the Lundy 1612 Colour Graphics subsystem to form a high-performance, very-high-resolution (1600- by 1200-pixel) color graphics workstation.

In addition to its 20-MHz 386 microprocessor, the SideCar 386 has a 64K-byte RAM cache on the motherboard and a 20-MHz 80387 math coprocessor. It also comes with 1 MB of 32-bit DRAM system memory, a 3½-inch 1.44-MB floppy disk drive, a 110-MB hard disk drive, a VGA interface, two RS-232C serial ports, and one Centronics parallel port. The eight IBM AT–type expansion slots include one 32-bit, one 8-bit, and six 16-bit slots.

Options include a 25-MHz 386 microprocessor with a 25-MHz 80387 coprocessor, up to 8 MB of 32-bit DRAM expansion, a 170-MB hard disk drive, a 60-MB quarter-inch cartridge tape drive, a 5¼-inch floppy disk drive, four serial ports, three parallel ports, and Ethernet with TCP/IP networking communications.

The Lundy 1612 Colour Graphics subsystem consists of a 19-inch, flicker-free, color raster monitor offering a resolution of 1600 by 1200 pixels, a dot pitch of 0.25 mm, autosync and multisync operation, and a 6-MIPS graphics controller. The controller uses a Texas Instruments TMS34010 32-bit Graphics System Processor and comes with 1 MB of display-list RAM, expandable to 4 MB.

The workstation can perform area fills at 48 million bps, line drawing at 1.2 million pixels per second, and text drawing at 25,000 characters per second and can display 16 colors simultaneously from a palette of 4096 shades. The Lundy 1612 features a driver for AutoCAD release 10 and optional software drivers for DGIS-compatible environments and programs such as Microsoft Windows, Aldus PageMaker, and Ventura Publisher.

Price: £5025 to £9485 for SideCar 386; £10,675 to £17,275 for the Lundy 1612 Workstation.
Contact: Lundy UK Ltd., Warrior House, 12–14 The Hard, Portsmouth, Hampshire PO1 3QU, UK, 44-705-863631.
Inquiry 906.

continued

Teleport lets you store up to 500K bytes of data that you want to be uploaded to another RS-232C device later.

Backup Supervisor Software

With Teleport, you can store up to 500K bytes of data in battery-supported RAM. You can connect the unit to any system with an RS-232C/V.24 interface and store data you want to download to another RS-232C device later.

Raw call logging can be output from the telephone exchange at any time and stored in Teleport. When your computer is available, you can download that data from Teleport. You can also use Teleport in conjunction with a modem for remote data collection applications.

You can individually configure Teleport's I/O ports from option switches at the rear of the unit. You can also individually select hardware or software control for each port. Indicators on the front panel show data coming in and out, power, power-failure warning, and the percentage of the memory used.

The unit has configurable data transfer rates of 300, 600, 1200, 2400, 4800, 9600, and 19,200 bps. The data format is 7 or 8 bits plus optional odd/even parity with handshaking for CTS and data terminal ready, plus optional X/ON and X/OFF.

Computer professionals know they should follow a sensible data backup cycle. The difficulty is getting them to do it. Cristie Electronics designed its new software package, called BUSS (for backup supervisor software), to solve this problem.

The computer manager uses BUSS to create a backup-cycle template for each user and then installs the software on each user's machine. Once installed, BUSS leads users simply and easily to back up the right files, at the right time, in the right sequence, and using the right tape. BUSS can fully control anything up to a full 10-tape backup cycle.

Every day, when you switch on your computer, BUSS greets you and asks you to do a backup then. Depending on the options chosen by the computer manager, you can choose to perform the backup right away or defer to a later time. In doing the backup, BUSS asks you to insert the appropriate tape from a numbered sequence. It checks that it is the right tape and then goes off to perform the correct backup for that day. When it has completed and checked the backup, BUSS updates a log on any hard disk drive connected to the system or network so the computer manager always knows how well the users are following the backup schemes.

If you defer a backup to be performed later but don't do it, BUSS will lock you out of the system until you do it. BUSS can also initiate backups according to the amount of data changed or the number of files accessed on the hard disk.

BUSS will run on any of Cristie's range of TS1000, TS1500, or Duo tape streamers.

Price: £895 for Teleport; £75 for BUSS; £499 and up for the tape streamers.

Contact: Cristie Electronics Ltd., Bonds Mill, Bristol Rd., Stonehouse, Gloucestershire GL10 3RG, UK, 44-45382-8821.

Inquiry 922.

Link PCs with STEbus Hardware

Arcom Control Systems' new PC-Link offers real-time systems designers a simple and low-cost means of linking PCs with industrial STEbus computer hardware for development of target applications. The package consists of two plug-in boards, implementing a software-transparent protocol converter or PC-to-STEbus bridge.

You can also use the IBM PC or AT as the control processor for the final target system, linked to as many as four daisy-chained racks—up to 84 boards—of STEbus I/O. The ribbon-cable link between PC-Link's boards allows the I/O in such systems to be as much as 15 meters away from the PC. You can even integrate PCs into sophisticated multiple-processor systems by virtue of PC-Link's optional STEbus arbitration capabilities.

PC-Link maps the STEbus memory and I/O locations into unused areas of the PC addressing range. It then masks out these areas on PC power-up except for one 8-byte letterbox location, which activates the link when written to. This lets you keep the PC-Link card permanently installed in its PC expansion slot without interfering with other system add-in functions such as networking cards or PROM programmers. When not operating as a PC-to-STEbus bridge, PC-Link defaults to provide an additional 32K bytes of RAM for the PC. Transfers between the PC and STEbus systems are completely transparent if they are less than 8K bytes in length. If they are greater, the PC is wait-stated.

Price: £495.

Contact: Arcom Control Systems Ltd., Unit 8, Clifton Rd., Cambridge CB1 4WH, UK, 44-223-411200.

Inquiry 949.

A Graphical User Interface Design Editor

Nihon Sun Microsystems' GUIDE (for Graphical User Interface Design Editor), an Open Look GUI development tool, is similar to the NeXT Computer interface builder and helps you design menus and buttons without programming.

You call programs by a button click and define them as parts attributes. GUIDE converts user definitions into its own G language and then also into C. At the present time, GUIDE runs only on the Sun Microsystems SPARC-Station.

Price: 50,000 yen.

Contact: Nihon Sun Microsystems K.K., Kowa 2-bancho Building, 11–19 2-bancho, Chiyoda-ku, Tokyo 102, Japan, 81-03-221-7021.

Inquiry 952.

continued

Multilingual Word Processing

You can buy the MultiWriter multilingual word processor in the U.K. from Candid Computers. The package features drop-down menus, context-sensitive help panels, and WordStar-compatible commands. While you are editing, you have simultaneous access to English, European special characters, and a user-definable alphabet set. Other features include split-screen editing, mail merge, table sorting, and four character sets (Arabic, Greek, Hebrew, and Russian).

The package gives you full multilingual word processing with features such as block moves; search and replace; paragraph indent; auto indent; full cursor control; quick jump to any place, line, or column in the text; headers and footers; and page numbering.

You can enhance your hard copy with boldfacing, enlarged type, horizontal and vertical lines, underlines, boxes, and frames. In addition, the font designer lets you create custom characters, keyboard layouts, and new alphabets.

MultiWriter runs on the IBM PC with 256K bytes of RAM (640K bytes for the laser version); DOS 2.0; Hercules graphics, CGA, or EGA; an 80-column graphics monitor; and two floppy disk drives or one floppy disk drive and a hard disk drive.

Candid Computers also offers other products in the range, including MultiCard (a multilingual research database) and MultiLibrary (a multilingual library management system).

Price: £149 and up.

Contact: Candid Computers, Premier House, 2 Gayton Rd., Harrow, Middlesex HA1 2XU, UK, 44-1-863-9001.

Inquiry 911.

Add Commands to DOS

SuperDOS adds internal commands to DOS. It lets you create light-bar menus, boxes, multiple windows, and scroll windows, and gives you control of screen colors, including special effects. You can also save numbers to variables and save and test character strings in the DOS environment. You can test printer status, write to the screen in different font sizes, force keystrokes into the keyboard buffer, and get numbers of character strings from the operator. In addition, SuperDOS lets you create a new complex screen display on a separate video page for instant display with page-switching commands. You can perform all these functions from the command line or standard DOS batch files, using only 27K bytes of memory.

SuperDOS runs on the IBM PC with DOS 3.20.

Price: £40.

Contact: S&S Enterprises Ltd., Weylands Court, Water Meadow, Germain St., Chesham, Buckinghamshire HP5 1LP, UK, 44-494-791900.

Inquiry 936.

continued

New Datatronics Pocket Modems

Digital Matrix offers new versions of the Datatronics 1200P Pocket Modem, a miniature external modem with full-size modem features. It is Hayes-compatible and supports Bell 102/212A and CCITT V.21/V.22 protocols for communication at 300 and 1200 bps using ordinary dial-up phone lines. The modems support the extended AT modem command set, including call progress detection. The 1200P automatically dials phone numbers using both tone and pulse-dialing methods. A built-in speaker permits phone line monitoring. It also automatically answers incoming calls and can receive transmissions unattended. When answering a call, the 1200P automatically selects the correct matching speed and protocol.

You can plug the 1200P modem directly into a standard RS-232C serial port. Powered by AC or a standard 9-V battery, it intelligently controls power consumption to extend battery life. An LED indicator notifies you when battery power is low.

The new versions are the Model 2400P, a high-speed pocket modem, and the Model 1200PN, a no-battery version of the 1200P that uses very-low-power CMOS technology and derives its operating power from the data-terminal-ready line of a standard RS-232C serial port. Both modems can run on systems using either Bell tones or the CCITT standard.

The Model 2400P, a battery-powered modem, supports the Hayes AT command set and runs at data transfer speeds of 300, 1200, and 2400 bps full-duplex. Other features include an internal monitoring speaker, LED indicators for status display, an RS-232C serial interface, leased-line and dial-up operation, and multiple telephone number storage.

The 1200PN operates at 300 and 1200 bps, full-duplex. It is Hayes-compatible and suitable for machines providing standard output on the RS-232C data-terminal-ready line (e.g., an IBM PC).

The 2100 Acoustic Coupler is designed for using a modem where a modular telephone plug is not available. Small enough to carry in a briefcase, purse, or jacket pocket, it lets you transfer data at speeds of up to 1200 bps. The coupler's design permits connection to most popular telephone sets, as well as all modems via the modular jack provided.

The Model 2100 has been fully tested with both new modems and offers operation at up to 2400 bps when you use it in conjunction with the Model 2400P modem.

Digital Matrix also offers the Datatronics 2488P, a pocket-size, battery-powered, Hayes-compatible modem that operates at data transfer speeds similar to the 2400P, with the addition of Group 3 fax send-only capabilities. DTFax software included for the IBM PC is capable of handling ASCII, TIFF, PCX, and other files automatically. The software also provides full scheduling and phone book management features.

Price: £85 for the 1200P; £175 for the 2400P; £95 for the 1200PN; £225 for the 2488P; £47 for the 2100 Acoustic Coupler.

Contact: Digital Matrix Ltd., 14 Arden Oak Rd., Sheldon, Birmingham B26 3LX, UK, 44-21-722-3828.

Inquiry 917.

continued

Electronic Forms Processing on the Mac

SmartForm Designer 1.1 and SmartForm Assistant 1.1 are updated versions of Claris International's electronic forms-processing products for the Macintosh. The new versions feature higher performance, improved forms management capabilities, and stronger integration with databases, spreadsheets, and other applications. You design professional-quality forms using SmartForm Designer and then fill them out electronically using SmartForm Assistant.

SmartForm Designer 1.1 supports Encapsulated PostScript. You can add sophisticated drawing effects (e.g., freehand illustrations, logos, graduated screens, or text on an arc) that you import from PostScript-based drawing programs, such as Aldus Freehand and Adobe Illustrator. You can also designate that entry fields in an electronic form be filled with pictures instead of words or numbers. In this case, you enter EPS- or PICT-based graphics disk files directly into the picture fields using SmartForm Assistant 1.1. SmartForm Designer 1.1 also recognizes additional date formats, such as dd/mm/yy and Julian calendar dates, for more flexible reformatting of date fields in forms that you complete with SmartForm Assistant 1.1.

SmartForm Assistant 1.1 helps you manage forms by grouping similar forms into a single file, thereby creating form sets. You can then perform database-like searches within a form set, such as "find all forms completed between January 1 and January 31" or "find all the expense reports filed in the last three months that exceed £100." In addition, you can export entire form sets to standard formats such as SYLK, DIF, DBF, and WKS to share form data with database or spreadsheet applications, including FileMaker II, Microsoft Excel, Lotus 1-2-3, and dBASE.

The Collect feature streamlines the process of importing information from existing forms into a single SmartForm form set. In addition, Collect performs the data transfer automatically, so you don't have to specify field names or file formats.

Claris Graphics Translator is a program that lets you share and import CAD drawings created with a variety of hardware and software systems with your Macintosh. You can transfer documents originally created in packages such as AutoCAD, VersaCAD, CADAM, Computervision, and Intergraph, which support DXF or IGES formats, directly to Claris CAD and vice versa. You can integrate your two-dimensional work from Claris CAD with 3-D design, modeling, and analysis software and share your designs among users with different 2-D CAD programs.

Claris Graphics Translator runs under Macintosh System Software 6.0 on the Mac SE and II.

Price: £295 for SmartForm Designer 1.1; £35 for SmartForm Assistant 1.1; £225 for Claris Graphics Translator.

Contact: Claris International, Inc., 1 Roundwood Ave., Stockley Park, Uxbridge, Middlesex UB11 1BG, UK, 44-1-756-0101.

Inquiry 941.

continued

Matrix Layout 2.0

HANNOVER MESSE CeBIT '90
World Center Office · Information · Telecommunications
21 - 28 MARCH 1990
Belgian Pavilion, Hall 6, Stand H15

Fantasy or Reality?

Imagine a development system that takes your ideas and moulds them into applications that can include WIMPS, CASE, OOPS and HYPERTEXT.
And then has the ability to show you how the application works, looks and feels before it codes it up into Microsoft C, Turbo Pascal, Lattice C, Turbo C, QuickBasic or an .EXE file at the touch of a button.

Matrix Layout turning your ideas into reality

MATRIX
EUROPE

Circle 454 on Reader Service Card

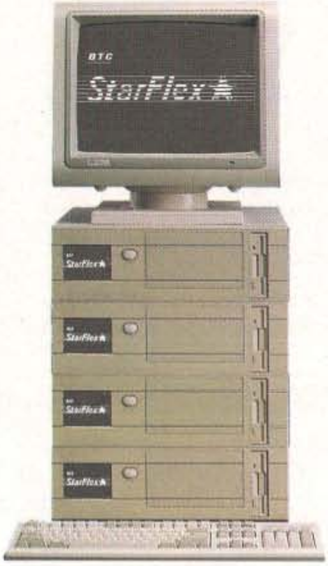
Matrix Europe N.V. Geldenaaksebaan 476 B-3030 Leuven Belgium Tel. +32 16 20 20 64 Fax +32 16 20 77 10

Please send me more information and a free demonstration disk

NAME	TITLE	
COMPANY		
STREET	POSTCODE	CITY
COUNTRY	TEL.	FAX

BT2

HIGH PERFORMANCE



386-33
386-25
386SX
286-16

What is high performance ? BTC "StarFlex" lets you know ...

High Compatibility

StarFlex series PC systems suit your needs at different stage from 286-16, 386SX, 386-25 to 386-33.
StarFlex is completely compatible with the widely used softwares like MS-DOS, LOTUS, dBASE III, OS/2, XENIX, AUTOCAD, etc. You name it!

Outstanding Stability

Solid anti-static, high temperature and humidity tolerant electronics enable StarFlex to maintain high stability under any climate. The series once set the record of being on line for consecutive 15 days.

Unbeatable price

We challenge you to find a computer that offers you more than our BTC StarFlex Series for less than our very reasonable price.

StarFlex Features and Specifications:

Standard Features	386/33	386/25	386SX	286/16
CPU	386	386	386SX	286-16
Speed(MHz)	33MHz	25MHz	16MHz	16MHz
Standard Memory	1MB	1MB	1MB	1MB
Memory Upgrades	8/16MB	8/16MB	5/16MB	5/16MB
Expansion Slots	8	8	6	6
40MB HD Drive 1.2MB/5.25" FD Drive 1.44MB/3.5" FD Drive	Your Choice	Your Choice	Your Choice	Your Choice

If you've been waiting for a high-performance computer, your wait is over, Call us today.

LOW PRICE

BTC BEHAVIOR TECH COMPUTER CORP.
HEAD Office : 12F, 18, Sec. 1, Chang An E. Rd. Taipei, 10404, Taiwan, R.O.C. Fax: (02)5233114 Tel: (02)5236266
U.S.A. Office : 46177 Warm Springs Blvd, Fremont, CA 94539 Fax: (415) 657-3965 Tel: (415) 637-3956
Europe Office: Glashaven 22, 3011 XJ, Rotterdam, the Netherlands. Fax: (10)433-2535 Tel: (10)404-9400

B 1/90-047-16710

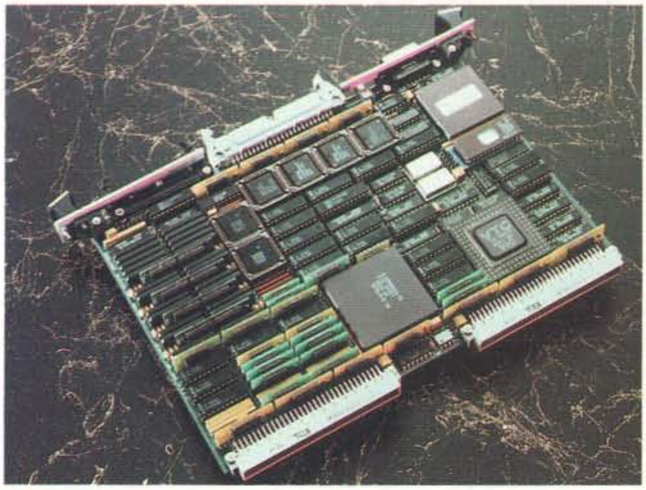
Circle 409 on Reader Service Card

Intel's i960CA RISC CPU for the VMEbus

GMT Electronics Systems says that its HK80/V960E is the first VMEbus CPU board based on Intel's i960CA RISC CPU. The board features a peak performance of 66 native MIPS and 30 VAX MIPS and is designed for real-time applications like intelligent I/O, communications, embedded control, and image processing.

The i960 32-bit RISC CPU delivers a peak operating frequency of 40 MHz and includes a 1K-byte instruction cache, 1K byte of static data RAM, and a four-channel 32-bit DMA controller.

The HK80/V960E includes either 2 MB or 8 MB of 70-ns, dual-access, static-column RAM, which employs a two-way interleaved architecture that can support zero-wait-state accesses for single-write or burst transfers.



You can use the HK80/V960E VMEbus CPU board for real-time applications like intelligent I/O, communications, embedded control, and image processing.

Additional memory support includes 1 MB of EPROM and 128 bytes of nonvolatile RAM, which you can use for storing user-definable data such as default data transfer rates, hardware or software revision levels, and system configuration information. You can also access an additional 960 MB of memory via the board's versatile subsystem bus interface.

The HK80/V960E also boasts a variety of networking and I/O capabilities. Ethernet support includes Intel's 10-megabit-per-second 32-bit 82596 Ethernet LAN processor, as well as TCP/IP and NFS. SCSI support includes Western Digital's ANSI-compatible WD33C93, which provides 1.5-megabyte-per-second asynchronous and 2-MBps synchronous transfer rates. Additional I/O support includes a Centronics-compatible parallel port and four RS-232C serial ports that provide software-programmable

continued

data transfer rates of 38,400 bps (asynchronous) to 1.5 MBps (synchronous).

The board's VMEbus Interface Consortium's VIC068 single-chip VMEbus interface provides peak VMEbus transfer speeds of up to 40 MBps and includes 32-bit data and address paths, seven bus interrupts, master and slave operation, and system controller functions. It also supports mailbox interrupts.

The HK80/V960E supports Unix development hosts from Sun workstations to Heurikon's Scalos development systems. The link between a Unix host and the board is implemented via the VxWorks cross-development environment, which includes driver support for SCSI and the Military Standard 1553A bus.

With VxWorks, you develop your application on a Unix host and download the code to a target HK80/V960E board. You can debug your code using a source-level debugger, which resides on the host, or a symbolic debugger, which resides on the target. You can implement the link between the Unix host and target board via Ethernet or a common backplane using Berkeley 4.2 BSD TCP/IP. File transfer utilities such as FTP let you access files resident on another system from a remote terminal as if those files were resident on your own disk. In addition, a remote log-in facility lets you control the target remotely from the host.

Price: £2900.
Contact: GMT Electronic Systems Ltd., 7 Mole Business Park, Leatherhead, Surrey KT22 7BA, UK, 44-372-373603.
Inquiry 910.

Hardcards for High-Performance Computers

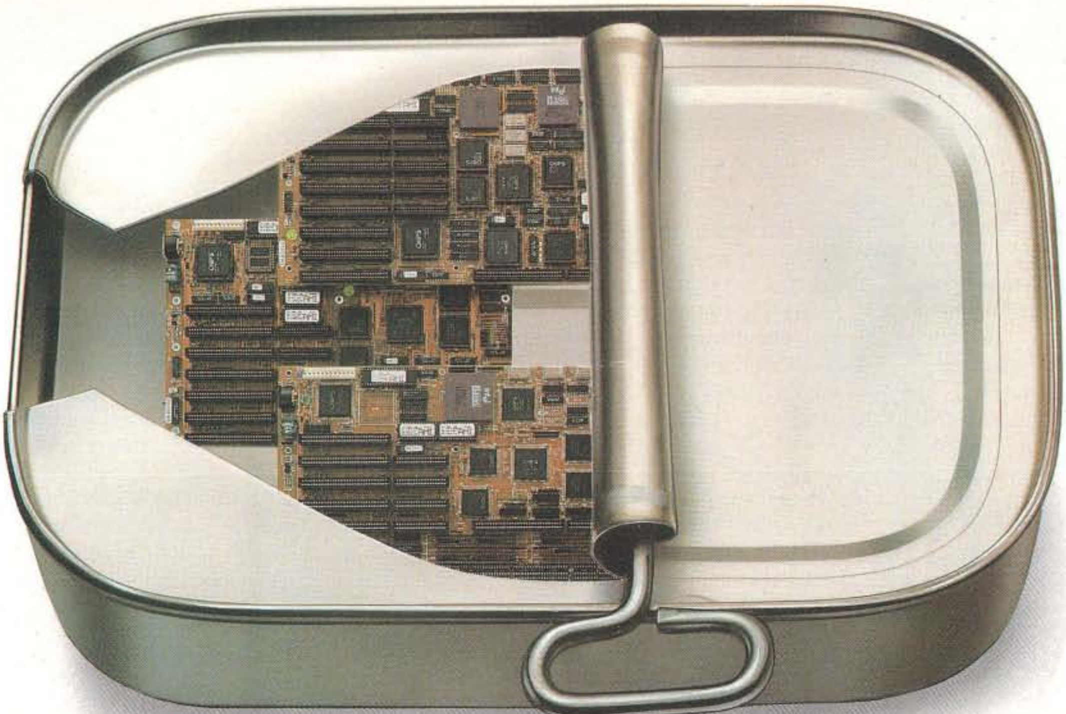
EasyFix Turbo IBM AT Hardcard drives are available in capacities of between 20 and 70 MB and are designed for high-performance 286, 386, and IBM PS/2 machines. They have disk-caching features, automatic error-correction capability, IBM AT interfaces, and integrated floppy disk drive controllers, which can support 360K-byte, 720K-byte, 1.44-MB, and 2.88-MB floppy disk drives.

You can use the Hardcards as a second or third hard disk drive in systems that already have a hard disk drive because you can change the interrupt address and disable the floppy disk drive controller. Each of the nine models has a data transfer rate of 8 Mbps and average access times ranging from 40 to 16 ms.

O.R. Computer System also offers EasyFix 3½-inch external floppy disk drives for the IBM XT, AT, PS/2s, and laptops; you can use standard high-density and extra-high-density floppy disks. Three drives are available that can read and write to 720K-byte, 1.44-MB, and 2.88-MB floppy disks (the EX-3D, EX-3HD, and EX-3XD, respectively). They are equipped with a Super BIOS that will not conflict with existing floppy disk drive controllers. The dimensions are 120 by 75 by 200 mm; the units weigh 500 grams.

Price: $390 to $1130 U.S. for the EasyFix Turbo IBM AT Hardcards; $140 for the EX-3D; $150 for the EX-3HD; $230 for the EX-3XD.
Contact: O.R. Computer System Pte. Ltd., 402 North Bridge Rd., #06-00, Jun Xin Building, Singapore 0718, 65-337-3387.
Inquiry 939.

continued



Food for thought:

Half a system is no system at all.

Feed on this idea. Imagine the absurdity of sitting down to half of a workstation and actually expecting to get your job done. Yet some vendors would have you saddled with the unappetizing predicament of receiving partial deliveries or waiting for technical support that is "on the way".

Partial solutions are hardly better than no solution at all. Come see AGC at the Hanover CEBIT or PC Forum to find out how we can serve up systems to order, in ways that are much more palatable.

HANNOVER MESSE CeBIT '90 21 - 28 MARCH 1990

Hannover CEBIT
Booth:
Halle 5-E63
PC Forum
Booth:
2M900

A486 Cache Main Board/System
Intel 80486 25 MHz CPU with built-in, enhanced coprocessor, built-in cache memory controller and 8 KB of cache memory. Software support for EMS 4.0 and shadow RAM. Supports page/interleaved mode. Expandable to 10 MB on board. 8 or 16 MB memory expansion cards available.

C386 Cache Main Board/System
80386 25 or 33 MHz CPU option, 80387 and Wietek socket. Designed with Chips 386 chipset. 32 KB cache memory (for 25 MHz CPU) or 64 KB cache memory (for 33 MHz CPU) with Intel 82385 cache controller. 8 or 16 MB memory expansion card option. Page/interleaved mode selectable. Cache hit ratio above 95%.

P386 Main Board/System
80386 20 or 25 MHz CPU option, 80287 or 80387 coprocessor option. Designed with Chips 386 chipset. SIPP RAM module sockets for up to 8 MB on board, with 8 or 16 MB memory expansion cards available. Page/interleaved memory mode selectable.

NESX (P-9) Main Board/System
80386SX 16 MHz CPU socket. 80387SX coprocessor option. Designed with Chips NEAT chipset. SIPP RAM module sockets provide up to 8 MB DRAM on board. Page/interleaved memory mode selectable with EMS 4.0 support.

Also available:
80286 NEAT main board, 16 , 20 or 25 MHz CPU's
80286 VLSI main board with VLSI chipsets
- All the above main boards are baby size.
- All trademarks are the legal property of their respective companies.

AGC TECHNOLOGY CORPORATION

AGC TECHNOLOGY CORPORATION
MAIN OFFICE - TAIWAN, REPUBLIC OF CHINA
2nd Floor, Number 481, Min-Sheng East Road
Taipei, Taiwan, Republic of China
TEL: (02) 500-6695 or (02) 502-9444
FAX: (02) 502-9194
TELEX: 15507 AGCELEC

CACHING TECHNOLOGY CORPORATION
NORTH AMERICAN OFFICE - UNITED STATES OF AMERICA
1250 North Lakeview Avenue, Unit Q
Anaheim, California 92807, United States of America
TEL: (714) 777-2818
FAX: (714) 777-3608

AGC TECHNOLOGY DEUTSCHELAND Gmbh.
EUROPEAN OFFICE - FEDERAL REPUBLIC OF GERMANY
Taiwan Trade Center-Dusseldorf
Room 616 Willi-Becker-Allee
11 Heinz-Schnole-Strasse 12
4000 Dusseldorf, Federal Republic of Germany
TEL: (0211) 7818-19
FAX: (0211) 7818-39
TELEX: 8582232 FETS D

AGC TECHNOLOGY CORPORATION SPAIN S.A.
EUROPEAN OFFICE-SPAIN
Paseo De la Castellana
222-3ro Izda.
28046 Madrid, Spain
TEL: (91) 315-4040
FAX: (91) 256-6457

Circle 402 on Reader Service Card

TEX and Metafont for the Archimedes

TooLs has implemented TEX and Metafont for the Archimedes RISC computer. ArchiTEX contains Donald Knuth's TEX 2.93, plain TEX, INITEX, and TEX TFM files. The package also includes the DVI driver for the screen and various printers. The Arc-Metafont package consists of Knuth's Metafont 1.7, INIMF, 10 utility programs, and the source files for the Computer Modern fonts of the TEX and LATEX systems.

ArchiTEX generates text output in book-printing quality. Its features include search paths for input and output files; implementing additional characters for other languages; libraries for TEX font metrics files and font files; a landscape print option; screen output using one, several, or no windows; selectable screen resolution allowing magnified and smaller output; an overview function; and support for packed pixel or pixel format files.

You can print pages in any sequence, which you define in a file, and substitute missing scaled fonts with unscaled fonts. ArchiTEX lets you take the page size and the size of the bit-map buffer from the postamble.

ArchiTEX requires an Archimedes computer with 1 MB of memory, an Arthur 1.2 or RISC operating system, one double-sided floppy disk drive, and a second floppy drive or a hard disk drive.

With Arc-Metafont, you can design fonts or small pictures, like logos, and use them with the text-formatting system, TEX 2. Metafont is a programming language in which you write a program for each letter of a font, which Metafont translates into a font set. The Metafont programs are essentially the definition of points, which you define using a system of linear equations.

You can use one Metafont program with different values for the parameters to generate fonts for a large number of output devices, independent of the resolution of the output device. You can also use the sources of the font files to generate complete font sets for new output devices in any resolution.

The Metafont package consists of Knuth's Metafont 1.7, including a version that uses the WIMP (window/icon mouse pointer) environment for on-line graphical output and that multitasks with RISC OS; plain Metafont source and base file; INIMF; utilities; and Metafont source files for the Computer Modern fonts of the TEX system and the source files for the fonts of the LATEX system. It requires an Archimedes computer with 1 MB of memory, one floppy disk drive, RISC OS, and a second floppy disk drive or a hard disk drive.

Price: £99 for ArchiTEX; £99 for Arc-Metafont.

Contact: TooLs GmbH, Kessenicher Strasse 108, D-5300 Bonn 1, West Germany, 49-228-230088.

Inquiry 916.

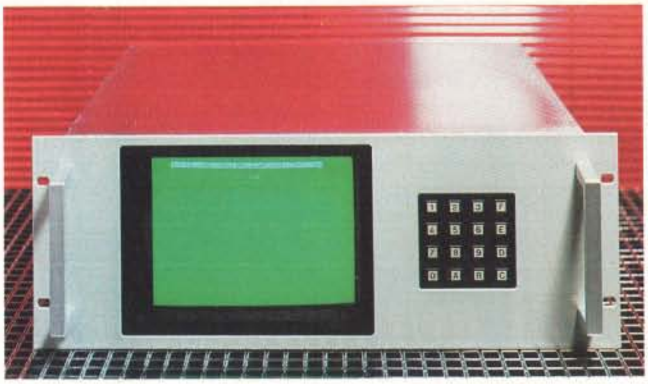
continued

Rack-Mounting Monitors

The RMT-916 rack-mounting terminal from Blue Chip Technology is a versatile operator interface for industrial or rack-mount applications that comes in several forms. As a monitor, it comes with a 9-inch monochrome or color screen and an interface that can be composite video, TTL, or CGA. Its sealed keypad has an RS-232C serial interface for communication with a host.

The stand-alone terminal version has built-in intelligence. It communicates over an RS-232C serial link and operates like a normal desktop terminal. You can send control codes to activate the screen and display messages, and your keypad input, in turn, generates coded messages back to the host.

The complete unit is only 7 inches high, and the case is nickel-plated to reduce electrical interference. The screen is sealed behind a Perspex panel that, combined with the sealed keypad, makes the unit's front panel splashproof and dustproof.



You can use the RMT-916 as a monitor or a terminal.

Blue Chip Technology also offers a range of 19-inch rack-mounting monitors that support the popular graphics standards, including EGA and VGA in color and monochrome.

Designed for use in hostile environments, these monitors are completely cased in nickel-plated steel and also feature a Perspex panel that protects the monitor tube against damage. The 19-inch rack-mounting unit has front-panel handles; cooling is by natural convection, although some models have a fan on the rear panel.

In addition to the rack-mounting monitors, a sealed keyboard is available on a 19-inch rack-mounting slide-out tray.

Price: £900 and up for the RMT-916; £480 and up for the rack-mounting monitors.

Contact: Blue Chip Technology, Main Ave., Hawarden Industrial Park, Deeside, Clwyd CH5 3PP, UK, 44-244-520222.

Inquiry 940.

Software for VMEbus Graphics

Mikro Elektronik offers software that provides the OS-9/68000 operating system with a multitasking window surface and supports most functions of the 82786 graphics processor, which is used on the company's A301 graphics board for the VMEbus.

The OS-9 window system consists of a complete library for C and assembly language, graphics drivers, a window file manager, and a toolbox, as well as a number of utilities. The system gives you a resolution of 768 by 512 pixels and permits several active processes with the A301 in different windows simultaneously; the number of windows is unlimited. The whole bit map or a part of it is shown in one window. The shown cutout of the bit map and the size of the windows are user-programmable through a set of coordinates. In addition, you can open several windows on one bit map, with each window showing the same or a different cutout.

Normally, several processes will want to access the mouse simultaneously. But, since only one process can operate effectively with the mouse at one time, the graphics driver analyzes the mouse coordinates and finds out in

continued

5 out of 5 hackers prefer other software protection methods to Hardlock E-Y-E.®

What hackers dislike...
Hardlock E-Y-E was designed using cryptographic principles. It took the experience and know-how of Germany's No. 1 in software protection and the leading edge technology of a US semiconductor company to create the ultimate software protection tool. Hardlock E-Y-E is based on a custom chip featuring secure algorithmic response rather than simple bit swapping or counting schemes.

What software developers like...
Hardlock E-Y-E combines all the features software developers require in a single product: algorithmic response to provide security and an optional non-volatile memory to allow custom configurations. FAST Electronic has made implementation of Hardlock E-Y-E in your software easy. Use HL-Crypt to protect .EXE or .COM files, or incorporate high level language interface routines in your software. The algorithm parameters and the contents of the memory can be programmed in seconds using our Crypto-Programmer card. This unique card guarantees that no one else can burn your original codes. Simply plug the card into any PC slot and start up your own Hardlock E-Y-E workshop.

What your customers will like...
Hardlock E-Y-E allows unlimited backup copies. The device is shipped with the software for the user simply to plug into the parallel interface and forget.

Daisy chainability, outstanding reliability (no battery is needed), and the most compact High-Tech design ensure that your customer will accept Hardlock E-Y-E.

What your accountant will like...
Hardlock E-Y-E needs no factory coding. This ensures optimum delivery schedules and stock flexibility. Revenues will go up as software piratry and multiple usage are prevented. Despite its wealth of features, Hardlock E-Y-E's prices remain competitive.

Hardlock E-Y-E
programmable, algorithmic response and memory option – all in one.

...As more and more software developers, customers and accountants appreciate the Hardlock E-Y-E device, hackers like it less and less.

For additional information contact Brahim Ajari at Fast Electronic or one of the distributors listed below:

France:
FAST Electronic France S.A.R.L.
9, Av d'Arromauches
94100 St Maur des Fossés
Tel: (1)-48837811
Fax: (1)-48839734

Italy:
TECHNE S.R.L.
Via della Pace, 94
41033 Concordia s/S. (MO)
Tel: (0535)-54178
Fax: (0535)-57070

Spain:
FAST Iberica, S.L.
c/Ricardo Ortiz, 56 Posterior
28017 Madrid
Tel: (91)-3613222
Fax: (91)-3613219

U.K.:
magnifeye Ltd.
Studio 6, Walmer Studios
235-239 Walmer Road
London W11 4EY
Tel: (01)-2218024
Fax: (01)-792 3449

BeNeLux:
crypsys gegevensbeveiliging
Arkelstraat 37
42001 KB Gorinchem
Tel: (01830)-37444/37069
Fax: (01830)-37083

Yugoslavia:
G & G electronic
Krizovljanska 1
41000 Zagreb
Tel: (041)-315794
Fax: (041)-333570

FAST
Fast Electronic GmbH

FAST Electronic GmbH, Kaiser-Ludwig-Platz 5, D-8000 München 2, West-Germany, Tel: 49/89/539800-20, Fax: 49/89/539800-40

Circle 432 on Reader Service Card

which window the mouse pointer is located, searches the corresponding bit map, and searches the corresponding process.

You can execute many applications quickly and simply because the software takes control of the GDP 92786 and the mouse. All functions are disposable in a C library, and you can use all the graphics possibilities and plot functions of the 82786 easily.

The A301 is a double Eurocard graphics subsystem for the VMEbus that incorporates the GDP 82786 graphics and display coprocessor, a CRT controller, and a bus interface unit, which supports 4 MB of memory. It supports several character fonts (which you can mix) and 256 colors at a maximum resolution of 650 by 500 pixels, or 50 colors at a maximum resolution of 1000 by 650 pixels. The 82786 gives you high-speed bit-block transmission between the graphics storage and the controlling CPU, as well as programmable video timing.

The communication with the host processor is done with the CPU writing a kind of graphics program into the dual-ported RAM and putting only the program count of the 82786 on this storage range. The 82786 then executes this program independently.

Price: 3980 deutsche marks for the graphics package, including the A301 board; 2650 DM for the A301 alone.
Contact: Mikro Elektronik GmbH, Wiesentalstrasse 40, D-8500 Nürnberg 90, West Germany, 49-911-332755.
Inquiry 958.

New Versions of Cameo Paint

Noble Campion offers two new versions of its Cameo Paint electronic painting package (see October 1989 What's New International, page 80IS-30). Cameo DTP gives you more than 120 drawing and imaging functions, including frame grabbing from a video camera, contrast enhancement, pattern propagation, single-degree raster rotation, multiple-size airbrushes, and image distortion. Other features include software pan and zoom, software stenciling, mixing of pictures with different palettes, and support for PCX and TIFF, so you can export images to popular desktop publishing programs like Ventura Publisher and Aldus PageMaker.

Cameo DTP requires an IBM AT with 640K bytes of RAM, DOS 2.0, a 20-MB hard disk drive, a VGA card, and a color monitor.

Noble Campion also offers a new TSR program called Cameo-Capture that lets you save computer screens from other packages as pictures and load them into Cameo Paint for later editing. The program works with packages like AutoCAD, letting you capture a CAD drawing and enhance it with Cameo Paint's painting features.

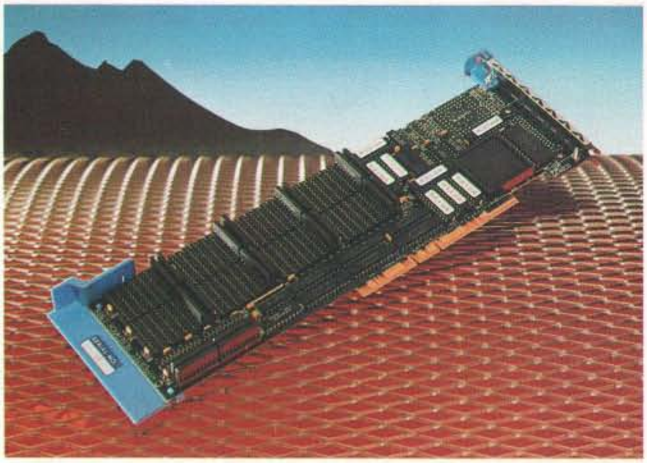
Cameo 3D is a visualization system for electronic model building that includes multiple light sources, multiple-position camera angles, full-color smooth shading, and antialiasing. You construct models on a four-window screen layout using element types from a library or by importing a DXF model and then creating objects from these elements. You can group objects into a scene and view them from any angle in colored solid form after you have specified the ambient light or added local, distant, or spot lighting. You can export completed views to Cameo Paint for further editing or output them to color printers or film recorders.

A tape-measure feature lets you set or check all measurements on-screen and gives you a numerical readout. Alternatively, keyboard control lets you enter *x,y,z* coordinates for accurate model building or movement. Text file input is useful for recording sequences of operations.

Cameo 3D requires an IBM AT with 640K bytes of RAM, an FPU, a 20-MB hard disk drive, a VGA card, a color monitor, and a mouse or digitizing tablet and pen.

Price: £430 for Cameo DTP; £540 for Cameo 3D.
Contact: Noble Campion Ltd., Premier House, 112 Station Rd., Edgware, Middlesex HA8 7AQ, UK, 44-1-951-5656.
Inquiry 924.

continued



The Hyperam MC 32/16 offers from 512K bytes up to 8 MB of EMS/XMS memory.

Make Your 286 Computer a 386SX

You can turn your 286 computer into a 386SX computer with Hyper 386SX, a very small printed circuit board containing a 16-MHz 386SX processor chip and additional hardware to fine-tune the chip for operation in 286-based machines.

To install Hyper 386SX in your 286-based machine, you remove the socketed 286 microprocessor from the motherboard and insert the Hyper 386SX in its place. Immediately, your 286 machine begins to operate as a 386SX. The 386SX offers the sophisticated memory-mapping capability of the 386 and full 386 code compatibility.

Hyper 386SX also features a mechanism to tune the 386SX processor to suit the clock speed of the machine you insert it into. In 6- and 8-MHz machines, you can set Hyper 386SX to double the clock speed and thereby improve processing power, as well as provide 386 code compatibility. For 10-MHz machines, you can multiply the clock speed by a factor of 1.5, and, in 12-MHz machines, you set the clock speed at a 1-to-1 ratio.

Three versions of Hyper 386SX are available: a pin-grid-array (PGA) socket version, a plastic-leaded-chip-carrier (PLCC) socket version, and a leadless-chip-carrier (LCC) socket version. The company says that the LCC version will be available in May.

Hypertec also offers the Hyperam MC 32/16, a new memory board that features a semicustomized application-specific integrated circuit (ASIC) chip. The new chip, a 6000-gate-array, 84-pin package, was developed for use in the new MC 32/16 board.

Designed for use in Micro Channel architecture machines, the Hyperam MC 32/16 offers from 512K bytes to 8 MB of EMS/XMS memory. You can use the board in both 16- and 32-bit machines, running as a 16-bit board in 16-bit machines such as the IBM PS/2 Models 50, 50 Z, 55, and 60, and as a 32-bit board in the 32-bit Models 70 and 80. This dual compatibility is an important benefit for users with a mix of 16- and 32-bit machines, and also for users who plan to upgrade to 32-bit systems in the future.

The Hyperam MC 32/16 offers complete hardware and software support for EMS 4.0 and, because the ASIC design incorporates the required memory for EMS mapping, you can perform these

continued

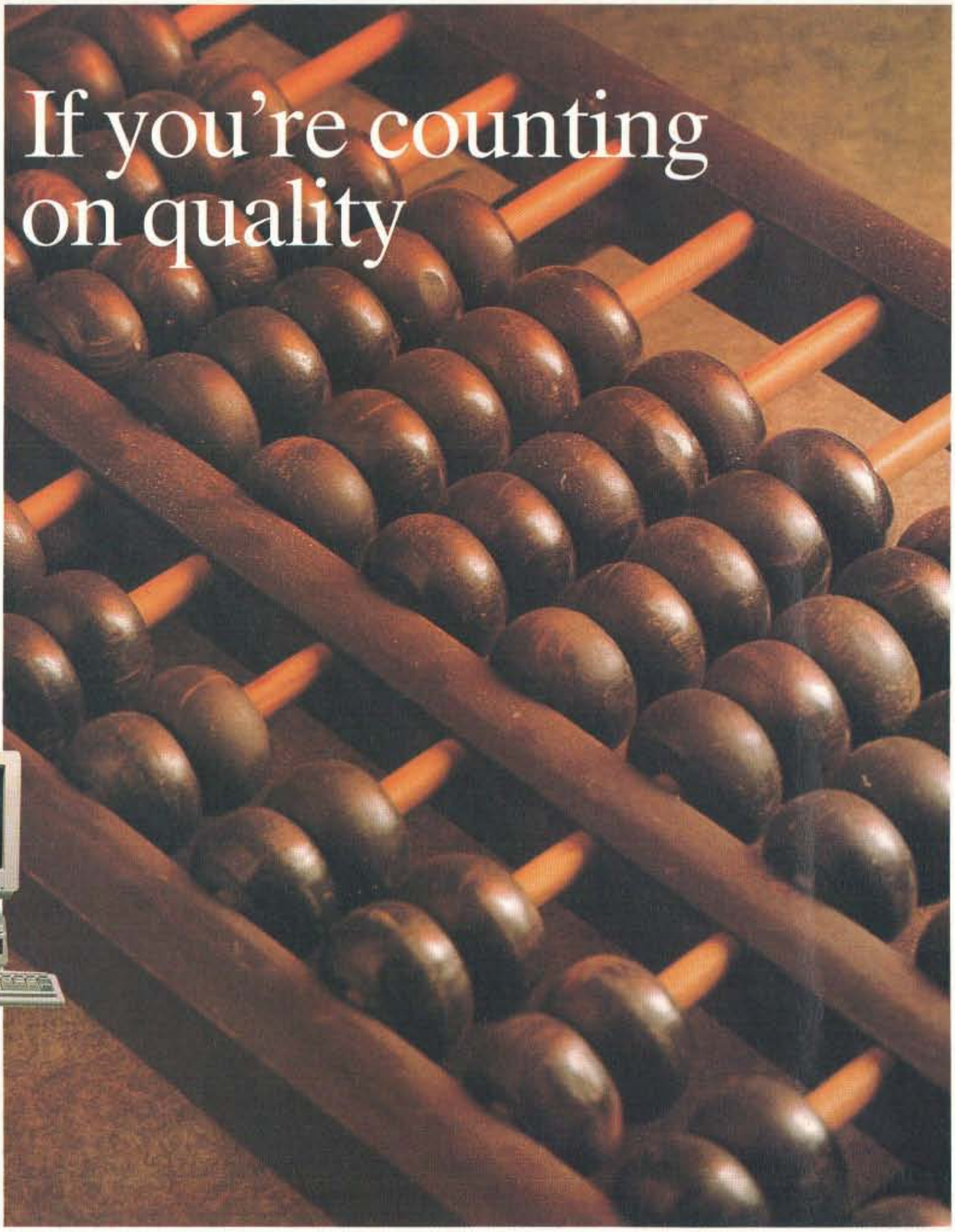
ASI 008 AT

ASI Slim Line AT & 386

ASI 009 XT

ASI Mini Tower AT, 386 & 386 SX

ASI 168 AT & 386 Laptop



The abacus has been a reliable counting method since time immemorial in the Far East. In today's world ASI's personal computers are just as reliable. They provide the best technology and are manufactured to the highest standards. Proven quality right across the range from the ultrareliable XT to the superfast 486 and the worldwide acclaimed Laptop 168. When it comes to prices ASI offers you a pleasant surprise. Compare them with those of similar machines and we think you'll agree. ASI has a system to suit you.

Call the European distribution centre and ask for the distributor in your country.

You can count on ASI

ASI

If you're in a hurry: 24 hours delivery!

European headoffice and bonded warehouse:
ASI Europe bv, Hoeksteen 137/1, 2132 MK Hoofddorp, telephone -31 2503 21241 telefax -31 2503 21239

Circle 405 on Reader Service Card

operations very quickly. You can also use the board to supply extended memory for OS/2, Xenix, and other protected-mode environments.

Memory configurations start at 512K bytes for 16-bit machines with 512K-byte upgrade increments, and at 1 MB with 1-MB increments for 32-bit machines.

A multifunction version is also available, offering one parallel and one serial port.
Price: £499 each for the Hyper 386SX PGA and PLCC versions; £980 for a 2-MB version of the Hyperam MC 32/16 board; £2897 for a fully populated 8-MB board; £1070 for a multifunction, 2-MB board; £2990 for an 8-MB board.
Contact: Hypertec (Europe) Ltd., Bank House, 40 High St., Pewsey, Wiltshire SN9 5AQ, UK, 44-672-63936.
Inquiry 951.

Super Macros for Lotus 1-2-3

If you use Lotus 1-2-3, then K.I.T.A.L. Software's new productivity tools, called Super Macros Library for Lotus 1-2-3, may interest you. The package is a collection of more than 160 macros that enhance and increase the power and efficiency of Lotus 1-2-3 release 2.0.

The Macro Library Manager puts all the macros just a few keystrokes away. It is the only part that you need to combine with the worksheet; you can activate all the other macros directly from the disk. The Macro Library Manager features a quick-run mode that uses the disk directory list display to point and shoot, and a search by keyword query to point to the matched macro description and shoot.

You can search and replace sets of characters through a defined range, including multiple occurrences in a cell. This macro features case sensitive, not case sensitive, replace all, find and replace, or skip. The Link macro lets you link any cells or ranges of worksheets in the disk. Any time you retrieve the worksheet, the macro updates the linked cells or ranges.

The Run Key macro activates the routines in the worksheet by pointing to the range/routine names mnemonics display list and shooting, thereby eliminating the need to use the Alt/Plus key combination to run a macro. The Macro Writer continuously writes macros, text, and formulas using prewritten syntax picked from the screen display for every Lotus macro keyword or function. The Macro Writer automatically knows when a formula is written and inserts it in the cell as a formula. The Word Processor macro has an adjustable line width and search and replace.

Bundled with the package is the menu-driven solver and calculator called the Scientific and Engineering Tool for Lotus 1-2-3, which features simple arithmetic, functions programming, physical units definition and conversion, integration and differentiation of functions and data tables, statistical functions, frequency and normal distributions, curve fitting (polynomial, exponential, powers, and linear), root finding of nonlinear equations, matrix operations, and a simultaneous linear equations solver.
Price: $69.95 U.S.
Contact: K.I.T.A.L. Software, P.O. Box 748, Karmiel 20100, Israel, 972-4-987255.
Inquiry 956.

continued

PRICES & DELIVERY

Prices do not include VAT or other local taxes but do include delivery in UK and Europe. Please check prices at time of order, ads are prepared some weeks before publication.

This page lists some of our products. Call us for a complete pricelist.

Order by phone with your credit card.

PASCAL LIBRARIES

TURBO PASCAL LIBRARIES

Power Tools Plus/5.0	PC-DOS	£105
Asynch Plus v5 (TP5)	PC-DOS	£135
Mathpak 87 (TP4&5)	MS-DOS	£ 85
Object Profess'nl(TP5.5)	PC-DOS	£ 90
Paragon Supertools (TP3)	PC-DOS	£ 65
RM Graph (TP3) Nimbus +	MS-DOS	£ 49
Science & Eng.Tools	MS-DOS	£ 55
Report Builder (TP3)	MS-DOS	£ 70
System Builder (TP3)	MS-DOS	£ 90
TP4 Developers Library	PC-DOS	£205
Turbo Halo Univ.Graph.	PC-DOS	£ 75
Turbo Analyst (TP4&5)	PC-DOS	£ 55
Turbo Database (TP4)	PC-DOS	£ 49
Turbo Editor Tlbox (TP4)	PC-DOS	£ 49
Turbo Gameworks (TP3,4)	PC-DOS	£ 35
Turbo Graphix (TP3,4)	PC-DOS	£ 49
Turbo Advantage (TP3)	MS-DOS	£ 60
Turbolink + v3.15A (TP3)	PC-DOS	£ 60
Turbopower Utils (TP3)	PC-DOS	£ 60
Turbo Optimiser (TP3)	PC-DOS	£ 45
Turbo Overlay M'ger(TP4)	PC-DOS	£ 29
Turbo Professional TP4&5	PC-DOS	£ 80
Turbo Screen	CP/M,MS-DOS	£ 55
Turbo Tutor (TP4&5)	PC-DOS	£ 49
TurboWINDOW/Pasc. (TP5)	PC-DOS	£ 75

GENERAL PASCAL LIBRARIES

Pascal Tools&Tools2(MS)	PC-DOS	£175
Pascal Asynch (s'ce MS)	PC-DOS	£130
Btrieve (MS&TP4)	PC-DOS	£170
MetaWINDOWS (MS&TP)	PC-DOS	£145
HALO '88 (MS,TP4)	PC-DOS	£230
Pascal View Mngr. (MS)	PC-DOS	£205
Shark database (Propas)	MS-DOS	£250
Prospect v2 (Pro)	MS-DOS	£ 80
Shark database (Propas)	CP/M-86	£250
Prospect Graphics (Pro)	CP/M-86	£ 80
Shark database (Propas)	CP/M-80	£150

THE C LANGUAGE

Hich C V1.6 has been considerably improved, with better Microsoft C compatibility, and new documentation

C COMPILERS

Avocet C	PC-DOS	£210
Aztec C86 Professional	MS-DOS	£120
Aztec C86 Developer	MS-DOS	£175
Aztec C86 Commercial	MS-DOS	£290
CI C86 Plus v1.3	MS-DOS	£290
ECO-C88 V4.0	MS-DOS	£ 70
HIGH C (Metaware) v1.5	MS-DOS	£420
HIGH C 386 v1.5	PL386&MS-DOS	£635
Hi-Tech C	MS-DOS	£135
Lattice C v6	OS/2&MS-DOS	£175
Mark Williams LETS C v4	MS-DOS	£ 60
Microsoft C v5.1	OS/2&PC-DOS	£250
Microsoft QuickC v2	PC-DOS	£ 60
M'soft QuickC/Quickasm	PC-DOS	£105
MIX C	MS-DOS	£ 20
MIX Power C & lib s'ce	PC-DOS	£ 29
Turbo C v2	PC-DOS	£ 79
Turbo C Professional v2	MS-DOS	£160
Topspeed C for OS/2	OS/2	£335
Topspeed C (std)	PC-DOS	£135
Topspeed C Professional	PC-DOS	£270
Watcom Express C v7	PC-DOS	£ 65
Watcom v7 opt comp + tls	PC-DOS	£250
Watcom C/386	PL386&MS-DOS	£625
Zortech C v3	PC-DOS	£ 45
Zortech C++ v2	PC-DOS	£120
Z'tech C++ v2 Developer	PC-DOS	£270
Aztec C86 Developer	CP/M-86	£245
Aztec C86 Personal	CP/M-86	£140
Hi-Tech C	CP/M-86	£135
Lattice C	CDOS	£395
HIGH C (Metaware)	Flex OS 286	£420
Avocet C	CP/M-80	£210
Aztec C Personal 1.06D	CP/M-80	£120
Aztec Commercial 1.06D	CP/M-80	£200
Eco-C w. Lib s'ce	Z80 + CP/M-80	£ 60
Hi-Tech C	Z80 + CP/M-80	£ 99
Mix C	Z80 + CP/M-80	£ 35
Toolworks C/80 v3.1	CP/M-80	£ 45
Aztec C65 V1.05	Apple DOS	£200
Aztec C65 V3.20	Apple PRO-DOS	£245
Aztec C68K MPW C	MACINTOSH	£110
Aztec C68K C	MACINTOSH	£ 75
Aztec C68K/AM Developer	AMIGA	£175
Aztec C68K/AM Prof'snl	AMIGA	£120
Aztec C68K/ST Developer	ATARI	£175
Aztec C68K/ST Prof'snl	ATARI	£120
Hi-Tech C	ATARI	£ 99
Lattice C	ATARI	£ 85
Mark Williams C v2	ATARI	£110
Laser C	ATARI	£135
Prospero C	ATARI	£105

C CROSS COMPILERS

We supply 2500AD, Avocet, Aztec, Lattice, IAR and Hi-Tech Cross Compilers hosted on MS-DOS and targeted on Z80, 6502, 6801, 68HC11, 6301, 6809, 7811, 8051, 8096, 68000 & 68020. Please call for information or advice.

C INTERPRETERS

Instant C/16M supports large programs on 286/386 machines.

C-terp V3.0X	PC-DOS	£165
Interactive C	PC-DOS	£195
Introducing C	PC-DOS	£ 85
Living C Plus	PC-DOS	£135
Instant-C v3	PC-DOS	£380
Instant-C/16M	PC-DOS	£680
RUN/C Professional	MS-DOS	£110

C LIBRARIES

Microsoft OS/2 Presentation Manager Toolkit is now in stock.

DATABASE

Btrieve	OS/2	£400
Btrieve v5	MS-DOS	£170
Btrieve/Network	MS-DOS	£400
XQL	OS/2,PC-DOS	£540
Xtrieve Plus	OS/2,PC-DOS	£400
C/Database T'lchest sce	PC-DOS	£ 39
CBTREE	(source any C)	£135
C-Index/Plus	(source any C)	£175
C-ISAM (L,MS)	MS-DOS	£220
C-tree	(source any C)	£230
Essential Btree (s'ce)	PC-DOS	£120
R-tree	MS-DOS	£170
db-VISTA III s'gle user	PC-DOS	£575
db-Query v2 s'gle user	PC-DOS	£575
Lattice dBCIII (L,MS)	MS-DOS	£165
Lattice dBCIII+ (L,MS)	MS-DOS	£385
SftFcus Btree&Isam (sce any C)		£ 80
Virtual Memory File Man.	PC-DOS	£ 80

GRAPHICS

Enhanced Graphics Tlkt	PC-DOS	£170
Essential Graphics v3	PC-DOS	£235
GFX Graphics	PC-DOS	£ 75
GraphiC v5 (CI,L,DS,MS)	PC-DOS	£290
Graphics Menu (MSC,TC)	PC-DOS	£105
GSS Kernel system	PC-DOS	£350
GSS Graph Dev Toolkit	PC-DOS	£350
GSS Graphic Plotting sys	PC-DOS	£245
HALO '88 (MSC5,LAT,TC)	PC-DOS	£230
HGraph (MSC)	PC-DOS	£ 80
Ingraf (MSC)	PC-DOS	£175
MetaWINDOW (CI,L,MS,T)	PC-DOS	£145
MetaWINDOW/Plus	PC-DOS	£190
MetaWINDOW/Premium	PC-DOS	£315
TurboWINDOW/C (Turbo)	PC-DOS	£ 75
QuickWINDOW/C (QC)	PC-DOS	£ 75

SCREEN & WINDOWS

Vitamin C (MS5.1)	OS/2&PC-DOS	£240
Power Screen (MS&TC)	PC-DOS	£105
Blaise View Mngr.(s'ce)	PC-DOS	£245
Lattice Curses w s'ce	PC-DOS	£130
Entelekon Windows(s'ce)	PC-DOS	£105
Multi-windows (MS,L)	PC-DOS	£220
Panel Plus II (source)	PC-DOS	£270
Vitamin C (source)	PC-DOS	£165
Vermont Views (MSC,TC)	PC-DOS	£345
Greenleaf Datawindow	PC-DOS	£180
Greenleaf Makeform	PC-DOS	£ 60
C-Scape v3.1 (MS,L,TC)	PC-DOS	£330
Zortech Windows(ZC++ZC3)	PC-DOS	£ 39
Curses/PC w. s'ce	PC-DOS	£265

GENERAL FUNCTIONS

C+O Class Lib (MS,TC)	PC-DOS	£155
C+O Cl's Lb (MS)WINDOWS&	PC-DOS	£155
C/Utilities T'chest sce	PC-DOS	£ 39
CQL s'ce	PC-DOS	£270
C-Worthy Int.Lib (L,MS)	MS-DOS	£175
Code Runner	PC-DOS	£105
D-Tree (source)	PC-DOS	£345
Greenleaf Functions s'ce	PC-DOS	£105
G'leaf Super Functions	PC-DOS	£135
G'leaf Business Mathlib	PC-DOS	£180
Smorgasbord C-food	PC-DOS	£ 65
C Tools Plus/6.0 (MS)	PC-DOS	£105
Power Search	PC-DOS	£105
Turbo C Tools v2	PC-DOS	£105
Essential C Utils s'ce	PC-DOS	£145
Entelekon Funct(source)	PC-DOS	£105
Pro-C & Workbench	PC-DOS	£350
Resident-C (MS,L)(s'ce)	PC-DOS	£145
The Heap Expander(MS&TC)	PC-DOS	£ 65
Zortech Supertext	PC-DOS	£ 39

COMMS LIBRARIES

C Asynch Manager V3s'ce	PC-DOS	£135
Essential Comms(L,MS,T)	PC-DOS	£195
Greenleaf Comms(source)	PC-DOS	£135
Multi Comms (L,MS)	PC-DOS	£165
Silvercomm C Asynch	PC-DOS	£145
Zortech Comms (QC&TC)	PC-DOS	£ 65
Zortech Comms(ZC++&ZC3)	PC-DOS	£ 65

SCIENTIFIC LIBRARIES

Wiley Scientif.Lib.v2	ANY C	£155
Mathpak 87 (L,MS)	MS-DOS	£ 85

PROGRAMMERS UTILITIES

PC-Lint	OS/2,MS-DOS	£ 85
C-Documentor	PC-DOS	£195
C-Scan	PC-DOS	£195
C Toolset	MS-DOS	£ 90
Clear+ for C	PC-DOS	£165
Lattice Comp Companion	MS-DOS	£ 65

REAL TIME & MULTI-TASKING TOOLS

Concurrent C (PC/MPX)sce	MS-DOS	£ 60
Multi C (L,MS,CI,TC)	PC-DOS	£165
Op.Sys.T'box (MS) s'ce	PC-DOS	£ 65
Timeslicer v3.01 (L)	PC-DOS	£175
Timeslicer v5 (MS)	PC-DOS	£175
Over-C (L,MS)	PC-DOS	£225

PROGRAMMING TOOLS

Ada Compilers	Algol Compilers
Assemblers & Libs	AWK
Basic Compilers	Basic Interpreters
Basic Utilities	Basic Libraries
BCPL Compilers	C Compilers
C Interpreters	C Libraries
C Utilities	Cobol Compilers
Comms.Libraries	Cross Assemblers
Database Libs.	Debuggers
Dis-assemblers	Editors
Engineers Libs.	Expert Systems
Forth	Fortran Compilers
Fortran Libraries	Graphics Libraries
Icon	Linkers/Locaters
Lisp	Modula-2
Nial Interpreters	OPS 5
Pascal Compilers	Pascal Libraries
Prolog	Rexx
Risc	Screen Libraries
Smalltalk	Snobol

We stock many items for which there is no space in these advertisements.

ADA COMPILERS

IntegrAda - The first Ada compiler with an easy to use Turbo-like environment.

Janus/Ada compiler	PC-DOS	£ 265
IntegrAda	PC-DOS	£ 645

DISK COPYING SERVICE

We can copy files to and from 600 disk formats including CP/M, CP/M-86, MS- DOS, PC-DOS, ISIS, APPLE, SIRIUS, BBC, TORCH, APRICOT, HP-150, TRSDOS, DEC RT- 11, IBM BEF, ATARI ST, AMSTRAD, MACINTOSH.

Our charge is £10.00 + disk + VAT with discounts on small quantities and disks are normally despatched within 24hrs of receipt. For more information call us.

GREY MATTER

2 Prigg Meadow, Ashburton, Devon TQ13 7DF

TEL. (0364) 53499

GREY MATTER

2 Prigg Meadow, Ashburton, Devon TQ13 7DF

TEL. (0364) 53499

GREY MATTER

2 Prigg Meadow, Ashburton, Devon TQ13 7DF

TEL. (0364) 53499

Circle 439 on Reader Service Card

Modular Software for Laboratory Applications

Designed for users who require flexibility rather than sophistication or high speed, WindMill (Windows for Microlink) offers a low-cost solution for simple data acquisition and control applications on an IBM AT.

The modular Windmill programs run under Microsoft Windows with the Microlink data acquisition system, which offers true multitasking for several data-handling routines. The individual programs are front-panel tasks for modules within the Microlink system and utility tasks appropriate to data acquisition and control such as charting analog data, logging data to disk, or sending out analog control signals.

You can load the individual programs or tasks and run them as required; they communicate with each other using the protocols defined for Windows. This allows each program to be dedicated to a well-defined group of functions, such as reading analog voltages from the Microlink and presenting them in engineering units. You can then pass the data values on to a utility program, for example, for graphical display in real time. When you use a standard communications protocol, the data can also be made available in real time to other software packages, such as Microsoft Excel, for on-line updating of a spreadsheet.

The WindMill programs are supplied with a copy of the MLCONFIG program, which you use to set up and maintain a file that describes the modules with the Microlink frame, their addresses, and their switch settings, so that all WindMill programs can determine the configuration without asking the operator. The MLCONFIG program is completely menu-driven and provides a very simple way of editing the description of the Microlink. If you add a new module to the system, or if you are using a module in a different mode through a change to the on-board switches, this information can be quickly made available to all software via the configuration file. A textual description is also produced, which you can print out and attach to the Microlink itself, so that other users can see how you configured the hardware.

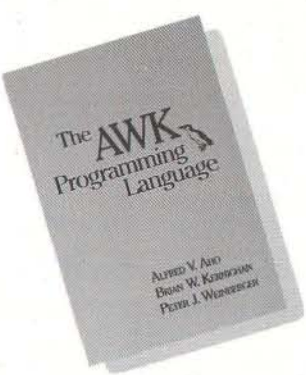
Front-panel tasks are available for each core module of the Microlink range. Each front panel gives you full control of the module's functions, so the front panel provides a quick and easy way to check out such factors as connections to the module, correct functioning of the module, and whether you have correctly specified the conversion to engineering units. You can save the setup of a particular module in a file for reuse.

Just as you choose the modules in your Microlink system to suit the data acquisition and control aspects of your application, so the modular nature of the WindMill programs lets you select both the individual module front panels and the utility tasks to set up the data acquisition and control functions you need in software. The utility programs include the Logger task, which lets you select a list of inputs on up to four modules that you want logged to a disk file. A single task can log up to 16 inputs, but multiple tasks can run concurrently if required. The Chart task presents a chart-recorder-type real-time display of up to four input channels, which can be from the same or different Microlink modules. The Output task provides simple analog

continued

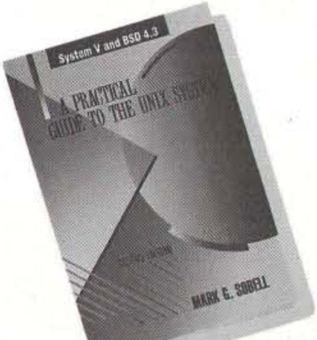
Read the signs of excellence.

The Design and Implementation of the
4.3 BSD UNIX Operating System
S. Leffler, M. McKusick,
J. S. Quarterman and M. Karels
448 pages, 1989
Hardcover
ISBN 0-201-06196-1



The AWK Programming Language
Alfred Aho, Brian Kernighan
and Peter Weinberger
224 pages, 1988
Paperback
ISBN 0-201-07981-X

The X Window System
A User's Guide
Niall Mansfield
348 pages, 1989
Paperback
ISBN 0-201-51341-2



A Practical Guide to the
UNIX System, Second Edition
(System V and BSD 4.3)
Mark G. Sobell
550 pages, 1989
Paperback
ISBN 0-8053-0243-3

OPEN LOOK Graphical
User Interface
Functional Specification
Sun Microsystems, Inc.
592 pages, 1990
Paperback
ISBN 0-201-52365-5

X Window System™
Technical Reference
Steven Mikes
832 pages, 1990
Paperback
ISBN 0-201-52370-1

Circle 401 on Reader Service Card

Meet ADDISON-WESLEY on:

March 21–28 CeBIT, Hannover, WEST-GERMANY, Hall 7, Booth A11
April 23–27 EUUG, Hotel Sheraton, München, WEST-GERMANY

BY 5 If you want to receive more information about ADDISON-WESLEY computerbooks, please fill in the coupon and send it to:
ADDISON-WESLEY · De Lairessestraat 90 · 1071 PJ Amsterdam
The Netherlands

Name ______________ Phone ______________
Address ______________
City ______________
Country ______________

ADDISON-WESLEY

De Lairessestraat 90 · 1071 PJ Amsterdam · The Netherlands output signals, split-time base logging, and variable chart speeds.

WindMill requires an IBM AT with 640K bytes of RAM, DOS 3.0, Microsoft Windows 2.03 or 386, a hard disk drive, EGA, and an IEEE-488 interface card.
Price: £95 for the core module front-panel tasks; £195 each for the chart recorder, logger, and output controller.
Contact: Biodata Ltd., 10 Stocks St., Manchester M8 8QG, UK, 44-61-834-6688.
Inquiry 918.

Optical Disk Storage for the Mac

Following the introduction of an optical disk storage package for the IBM PC, Mitsubishi Electric UK is offering a similar package for the Mac Plus, SE, SE/30, II, IIx, and IIcx. The new package is based on Mitsubishi's high-speed MW-5U1 drive and Corel's controller software. The MW-5U1 WORM (write once, read many times) package comes with a SCSI cable that hooks up with the Mac's SCSI controller.

The MW-5U1 drive is a compact external device measuring 240 by 142.4 by 285 mm. It can store 300 MB on each side of a removable optical disk cartridge for a total of 600 MB of storage capacity.

The Corel software operates with System File 4.1 or higher and requires 1 MB of RAM when you run it under the Finder, or 2 MB of RAM under MultiFinder. The exact amount of memory required depends on which Desktop accessories and other device drivers you have installed. Corel's software allows the MW-5U1 to act as a standard Mac read/write device and is therefore compatible with any Macintosh program. Whenever you save a file to the optical disk, a completely new version is written, meaning that previous versions are never lost and you can review them at any time using Corel's audit trail function.

The MW-5U1 package contains the drive, one 600-MB disk cartridge, a SCSI cable, and controller software. It offers an average random access time of 80 ms, a track-to-track seek time of 1 ms, and an average positioning time of 63 ms. It clocks up a data transfer rate of 5.5 megabits per second.
Price: £2500.
Contact: Mitsubishi Electric UK Ltd., Electronics Division, Travellers Lane, Hatfield, Hertfordshire AL10 8XB, UK, 44-7072-76100.
Inquiry 954.

A Pocket Ethernet Adapter

You can use the Corvus Pocket Ethernet Adapter to connect IBM PCs to an Ethernet or IEEE 802.3 LAN. The unit comes in the form of a small box, measuring approximately 5 by 1 by 2½ inches and weighing only 5 ounces, which you plug into the parallel port of the PC.

The memory size of the network buffer is 8K bytes by 8 bits with 256-bit EEPROM configuration storage. The data transfer rate is 10 megabits per second, and the unit has a loopback self-test capability. The Pocket Ethernet Adapter also comes with PC/NOS and Novell NetWare drivers on 5¼- and 3½-inch floppy disks.
Price: £495.
Contact: Corvus Systems (UK) Ltd., James House, 27–35 London Rd., Newbury, Berkshire RG13 1JL, UK, 44-635-580300.
Inquiry 923.

continued

We also provides

*VGA card 8 bit/16
*386 sx M/B
*8514 A card and 8514 A monitor
*386-20/25/23 M/B
*MultiScan/VGA color monitor
*Multi user card
*286-12/XT Lap-Top

OEM & DISTRIBUTORS WELCOME!

AURORA TECHNOLOGY CORP.

Wealsoft Computer Showroom
1 Rochor Canal Road,
05-14 Sim Lim Square, Singapore 0718.
Tel:3371414 Fax:3387191

JPM Computer Supplies Corp.
Rm 304/307,Marina Bldg., 282 Vito Crue Ext.,
Makati,Metro Manila Philippies
Tel:880634/871721 Fax:871721

7F,499,Chung Cheng Rd.,Shin Tien Taipei Hsien,Taiwan,
R.O.C. Tel:886-2-9120115/7,9186849,9186854.
Fax:886-2-9112007. Telex:33561 ATCTWN.

Circle 408 on Reader Service Card

Unix Computers with VME Technology

The QS family of microcomputers, based around Torch Technology's VME board technology, comes with standard features such as Unix, OpenTop or the X Window System, color graphics, Ethernet, synchronous and asynchronous communications ports, a floating-point coprocessor, an OpenChip DMA controller, a high-quality audio output, a full 32-bit VME interface, and a SCSI port.

The entry-level model, the QS1000, is based on a 68010 processor. It comes with 2 MB of RAM, an 80-MB hard disk drive (or, optionally, a 190-MB hard disk drive), and a 5¼-inch 720K-byte floppy disk drive. The optional 3½-inch floppy disk drive and high-speed tape streamer enhance its flexibility. The QS1000 uses the OpenTop iconic Unix interface.

The 68020-based QS2000 offers 4 MB of RAM, a 5¼-inch 720K-byte floppy disk drive, 736- by 512-pixel color graphics, and an 80-MB hard disk drive, with three expansion slots on the internal VME backplane. Options include a 68030 processor; a 190-, 300-, or 700-MB hard disk drive; an additional floppy disk drive; a tape streamer slot; an external 8-mm tape backup unit; and Y-OpenTop, Torch's X Window System and iconic desktop manager.

Torch has taken the standard Unix benefits, including multitasking, interprocess communications, a rich tool set, and extensive communications facilities, and added enhancements such as a full demand-paged virtual memory system, floating-point coprocessor support, and BSD Unix extensions.

The QS2000 was designed with communications in mind—all systems are supplied with Ethernet or IEEE 802.3 networking capabilities, an RS-232C/423 serial asynchronous link, and an X.25 serial synchronous link, which support protocols including TCP/IP, X/29, NEF, BNET, UUCP, Kermit, and Telnet/FTP.

The QM2000 is a multiuser Unix system designed to meet the processing needs of two to 10 concurrent users. Torch has designed and implemented efficient user interfaces, coupled with the X Window System to offer a multiuser system where every terminal has a windowed interface. This gives you an intuitive desktop-style interface; clear, customizable icons; a programmable user interface; and an individually configurable screen environment.

Standard features include a 68020 CPU, a 68851 paged memory management unit, a 68881 FPU, 4 MB of RAM, an 80-MB hard disk drive, a 5¼-inch floppy disk drive, Ethernet, 10 RS-232C serial ports, a 32-bit VME interface, an external SCSI connector, an audio output, and serial keyboard and mouse input. Optional features include 736- by 512-pixel color graphics; a 68030 CPU; a 3½-inch floppy disk drive; a quarter-inch tape cartridge drive; a 190-, 300-, or 700-MB hard disk drive; an external digital tape drive; X.25 software pack; X Window System; and Y-OpenTop.
Price: £2000 for the QS1000; £4500 to £9500 for the QS2000; £5500 to £15,000 for the QM2000.
Contact: Torch Technology Ltd., Abberley House, Great Shelford, Cambridge CB2 5LQ, UK, 44-223-841000.
Inquiry 920.

continued

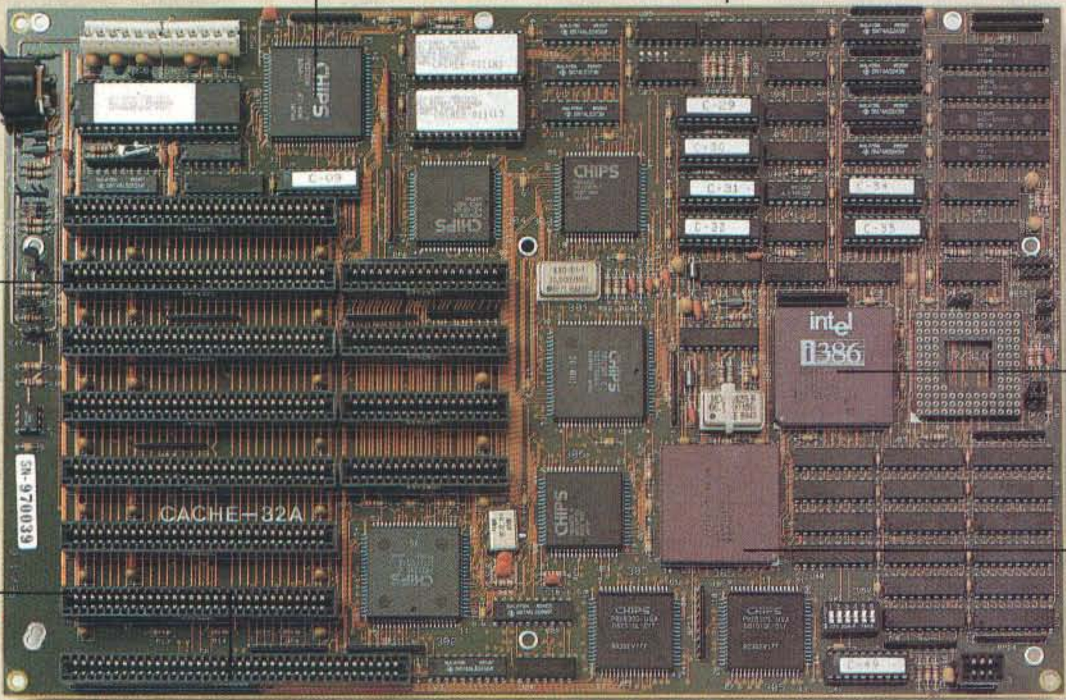
CACHE 33

The way we see it

THE WHICH COMPUTER? SHOW
STAND NO:3340 HALL:3

Chipset support
More reliable design

Baby size
High integration, more reliable



Expansion slots
Three 8 bit slots
Four 16 bit slots

Memory expansion
Up to 16MB main memory using 100ns DRAM

80386-33MHz CPU
Fast power for high-end application

CACHE design
INTEL 82385 with 32KB CACHE memory

Fast and powerful than any, the 80386-33 MHz is the choice for high-end applications. Designed with Intel 82385 with 32KB cache memory, it maximizes network throughput. It also features expansion slots of three 8-bit slots and four 16-bit slots. Plus a memory expansion of up to 16MB using 100ns DRAM. What's more, our chipset is of a more reliable design and our baby sizes are highly-integrated and more trustworthy.

ECS ELITEGROUP

ELITEGROUP COMPUTER SYSTEMS CO., LTD. **Headquarters:** 152 Ta-Yeh Rd., Peitou, Taipei, Taiwan, R.O.C. Tel: 886-2-895-1285 • 886-2-895-1272 Fax: 886-2-895-1294 Telex: 16499 ELITEGO **W.G. Subsidiary:** Harkortstrasse 25, 4030 Ratingen 1, West Germany Tel: 2102-45100 Fax: 2102-451020 **U.K. Subsidiary:** Unit 10 Victory Business Centre Worton Road, Isleworth TW7 6DB U.K. Tel: 01-847-3332 Fax: 01-568-7761 **U.S. Subsidiary:** 365 Ravendale Drive Mountain View, CA 94043 U.S.A. Tel: 415-969-1000 Fax: 415-969-0343 **L.A. Office:** 12020 Mora Dr. Bldg 8, Suite 9, Santa Fe Springs CA 90670 U.S.A. Tel: 213-944-2881 Fax: 213-944-4970

Circle 431 on Reader Service Card

A Pesticide Reference on CD-ROM

Pergamon Compact Solution and the Royal Society of Chemistry have compiled the latest data on thousands of pesticides, including toxicity, chemical name, and structure, on a single CD-ROM.

The Pesticides Disc lists fungicides, bactericides and virucides; herbicides and algicides; insecticides, acaricides, and nematicides; and plant growth regulators, rodenticides, and molluscicides. The information is organized in four integrated files on the CD-ROM: the European Directory of Agrochemical Products, which provides technocommercial information on 23,000 formulated products; the Agrochemical Handbook, which gives chemical, physical, analytical, toxicological, and usage data along with the common and trade names and Chemical Abstracts Registry numbers of 700 active ingredients used in pesticide products worldwide; a Pesticides Index, which gives you product information and distributor details on approximately 25,000 products worldwide; and an Address List of some 1500 companies that manufacture or market pesticides and crop-protection products around the world.

On-screen prompts guide you at each stage of a search, and every word is indexed, so your searches are not limited to just product ingredient or company name.

The Pesticides Disc requires an IBM AT with 640K bytes of RAM; DOS 3.1; Hercules, CGA, or EGA; a mouse; and a CD-ROM drive with DOS CD-ROM extensions. The company plans to update the product every six months.

Price: £950 for an annual subscription.
Contact: Pergamon Compact Solution, Irwin House, 118 Southwark St., London SE1 0SW, UK, 44-1-928-1404.
Inquiry 909.

A Data-Communication Interface Module

Philips's new data-communication interface module, called the VI21, lets you include its PC20 programmable controller system as a master in hierarchical networks using the standard PPCCOM protocol. Depending on the VI21's configuration, the PC20 system can act as a master for up to 16 slaves or as a slave for a host system, which can be a personal computer, VMEbus system, or another PC20. The support program contains a library of macros that help you control the data transfer between the PC20 and VI21.

The module communicates with PC20's data memory via the I/O bus and with other devices via its RS-485 interface. It allows data transfers in blocks of up to 128 nibbles at a rate of up to 19,200 bps.

In one PC20 system, you can configure up to four VI21 modules as masters, allowing you to connect a maximum of 64 slaves. A PC20 with VI21 in slave configuration can be the master of another network with members of Philips's programmable logic controller family.

Price: 2000 Dutch guilders.
Contact: Philips Industrial & Electro-acoustic Systems Division, I&E Press Office, Building HKF, 5600 MD Eindhoven, The Netherlands, 31-40-788620.
Inquiry 935.

continued

Circle 411 on Reader Service Card (DEALERS: 412)

PCs with CD-ROMs

Elonex offers a range of personal computers that incorporate Hitachi CD-ROM technology. You can daisy chain the CD-ROM Stations to additional CD-ROM players to gain access to more than 4 gigabytes of data.

The Elonex PC-88C CD-ROM Station comes with Hitachi's CDR-3650 internal CD-ROM player, 640K bytes of RAM, a 5¼- or 3½-inch floppy disk drive, a 14-inch tilt-and-swivel monochrome monitor, a 102-key Enhanced keyboard, a Microsoft-compatible mouse, DOS 3.3, GWBASIC, and the GEM/3 graphics environment. The Elonex PC-286M CD-ROM Station is a similar system based on a 286 microprocessor.

The Hitachi CDR-3650 drive features an embedded SCSI controller with a 64K-byte RAM buffer. It supports two-channel audio output and gives you an average access time of 0.35 second.

Elonex also offers a family of low-cost, high-resolution graphics workstations based on Intel's 386 microprocessor. The Elonex 386 Graphics Workstation range features a 20-inch color display offering resolutions of up to 1280 by 1024 pixels.

All the models in the Graphics Workstation range include a high-speed hard disk drive with a capacity of 40 MB or more, a high-density 3½- or 5¼-inch floppy disk drive, a Hitachi Hi-Scan 20 multiscanning color monitor, a 512K-byte VGA card, a 102-key keyboard, a Microsoft-compatible mouse, DOS 4.1, and Microsoft Windows/386. The standard 16-MHz 386SX Graphics Workstation comes with 1 MB of memory (expandable to 8 MB). The 20-MHz 386 version also comes with 1 MB of memory (expandable to 16 MB).

The Hitachi Hi-Scan 20 monitor offers resolutions of up to 1280 by 1024 pixels with a trio dot pitch of 0.31 mm. It automatically adjusts to scanning frequencies of between 30 and 64 kHz horizontal and 50 and 100 Hz vertical with no reduction in picture size. Options include higher-capacity hard disk drives, larger memory, and math coprocessors.

The Elonex PC386V-330 family of high-speed 32-bit computer systems is based on the 33-MHz 386 microprocessor. The systems are designed for multiuser and network environments and for demanding single-user applications such as CAD/CAM and desktop publishing.

The machines combine the powerful 33-MHz 386 microprocessor with a 25-ns RAM cache and an Intel 82385 cache controller to deliver very fast performance. They utilize the Phoenix BIOS and provide up to 16 MB of paged interleaved memory directly on the system board.

Housed in a floor-standing tower case, the Elonex PC386V-330 models can accommodate up to seven half-height storage devices. Two parallel and two serial ports

continued

Get Smart. Give Your Laser Printer a Super IQ.

BEST OF 1989 Edward Mendelson PC Magazine Printer Fonts Super Cartridge 2 January 16, 1990

PC MAGAZINE EDITORS' CHOICE June 13, 1989 IQ Engineering Super Cartridge 2

The Smartest Font Cartridge Ever — Now Compatible with the HP LaserJet™ IIP.

With the IQ Engineering Super Cartridge 2, your laser printer will work smarter than ever before. You'll enjoy more fonts and better fonts, with faster performance. And you can be sure of full compatibility with your printer and the most popular software programs.

It's a member of the IQ Engineering family of products. From the company that pioneered super font cartridges for HP LaserJet printers and compatibles.

More and Better Fonts.

The Super Cartridge 2 has a vast selection of fonts and special characters in three extended symbol sets, including full Roman8. Each typeface comes in every size your software allows — from 4 to 30 points! Even the highly readable 11-point size no other brand of font cartridge has.

The Best Laser Printer Performance.

With IQ Super Cartridges, you can print image fonts in seconds, instead of minutes.

You won't have to worry about compatibility either. Your printer will be smart enough to work with WordPerfect, Microsoft Word, Windows, Display Writer, Lotus 1-2-3, MultiMate, Aldus PageMaker, Q & A Write, Samna Ami, Ventura Publisher, and WordStar 5.0, to name a few.

Get As Much IQ As You Need.

With an entire family of IQ Super Cartridges, you can choose the exact printing capabilities you need. Or start with our word processing cartridge, the Super Cartridge 2WP. And later when you need more capability, we make upgrading easy and cost-effective.

Choose the Super Cartridge 2, priced at $599. Or any of our many other cartridges, priced from $399. And if printing full-page graphics or adding even more fonts is important to you, get one of our memory upgrade boards.

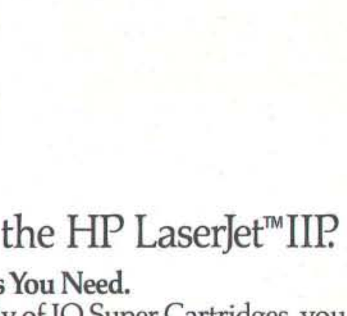
Call Today.

For more information about IQ Super Cartridges, or the name of a dealer near you, call.

Or write us at 685 N. Pastoria, Sunnyvale, CA 94086.

And make your laser printers as smart as they can be.

1-800-765-FONT.
Canada: 1-800-663-6157



IQ ENGINEERING

Circle 445 on Reader Service Card (DEALERS: 446)

W. Germany: 02161/65980 or 06172/459094 • France (1) 40.26.22.32 • The Netherlands: 070-907051 • United Kingdom: (01) 665 5650 • Switzerland: 042-362040
Hong Kong: 5-8400336 • Malaysia: 3-2482900 • Australia: (02) 819-6811 • New Zealand: 4-4990967 • U.S.A.: (408) 733-1161

come standard, and five IBM AT-type slots are available for expansion options and peripherals.

The entry-level model comes with a 28-ms 40-MB hard disk drive, a 5¼-inch 1.2-MB or 3½-inch 1.44-MB floppy disk drive, 4 MB of RAM, a high-resolution monochrome Hercules-standard display, a 102-key keyboard, a Microsoft-compatible mouse, DOS 4.1, Microsoft Windows/386, and Microsoft Works integrated business software. A color VGA model is also available.

Price: £990 for the PC-88C CD-ROM Station; £1195 for the PC-286M CD-ROM Station; £3370 for the PC386SX-160 Graphics Workstation; £3670 for the PC386S-200 Graphics Workstation; £3295 and up for the PC386V-330 range.

Contact: Elonex plc, Rays House, North Circular Rd., London NW10 7XB, UK, 44-1-965-3225.

Inquiry 942.

The Paperless Factory

Finally, the paperless factory is a reality with FabMaster, a system that replaces all drawings, tapes, and listings, allowing manufacturing and assembly personnel to exploit all of a CAD system database without the risk of introducing human errors.

Without altering the original design, you can manipulate data using graphical tools and then output it for production requirements such as manual assembly, insertion machines, testers, inspection, drilling, profiling, and wire-wrap.

An icon-driven multilingual user interface with on-line help reduces training time, according to the company. You can also graphically view and output data using commands for selecting data by part, drill, copper, and signal connection and for manipulating boards by rotation, datum point, and top/bottom view. Optimization of insertion and drilling paths before output increases manufacturing efficiency, and automatic comparison and graphical highlighting of the differences between two revisions of the same board helps production personnel introduce design changes quickly and accurately.

Comprehensive ASCII data output for factory-floor machines includes interfaces to systems from Dynapert, Excellon, Gardner Denver, Genrad, Mania, Marconi, Olivetti, and Teradyne.

FabMaster runs on the IBM AT with 640K bytes of RAM, DOS 3.20, and EGA or VGA.

Price: 9000 to 35,000 Swiss francs.

Contact: Academi Systems SA, 50 ave. de la Praille, CH-1227 Geneva, Switzerland, 41-22-43-27-60.

Inquiry 948.

A Programming Toolkit for 3-D Graphics

You can create graphical output—from simple wire-frame drawings to sophisticated images—with MiraShading, a programming toolkit for high-end three-dimensional computer graphics that runs on transputer systems supporting Helios.

The package uses 32-bit floating-point world coordinates. You compose graphical objects from polygons, but MiraShading also provides geometric primitives like spheres and cylinders, so you can efficiently render those object types. The software automatically converts between the representations; if, for example, it transforms a sphere in a nonlinear way that makes a parametric representation impossible, it then automatically breaks the object down into polygons.

Four basic rendering techniques let you start with wire-frame drawings and proceed to fast *z*-buffer hidden surface elimination or to a scan-line algorithm that gives you photo-realistic images with anti-aliasing, shadows, transparency, and texture mapping. An accelerated ray-tracing method helps you generate high-quality images with true refractions and mirror effects. Another option lets you create stereo images.

The MiraShading libraries consist of object creation and manipulation, transformation and alteration, object display and camera control, texture mapping, graphical input, object file handling, internal data access, hierarchical object management, and utilities.

Features include predefined graphical types; predefined object transformations, deformations, and other modifications; virtual camera control and manipulation; complex light sources; texture primitives for solid textures and image mapping; shading, including Lambert, Gouraud, Phong, and Inter-Phong; object display by wire-frame, scan-line, *z*-buffer, or accelerated ray tracing; support for multiple processors and special rendering hardware; and support for various output devices and a toolkit for

continued

Buy One. Get 24 Free.

Buy *25 Cartridges in One!* and you'll get 172 fonts from 25 different cartridges—all for about the cost of a single cartridge! That's because we've combined 172 fonts and symbol sets all in one cartridge!

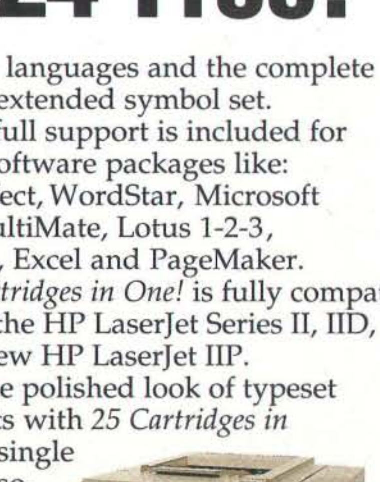
Just plug *25 Cartridges in One!* into your printer and gain immediate access to more high quality fonts than ever before. You don't need to download soft fonts or switch cartridges in and out of the printer looking for the right font.

With 172 fonts, *25 Cartridges in One!* has a perfect font for every application. It contains punctuation and currency symbols for 10 different European languages and the complete Roman 8 extended symbol set.

And, full support is included for popular software packages like: WordPerfect, WordStar, Microsoft Word, MultiMate, Lotus 1-2-3, Windows, Excel and PageMaker.

25 Cartridges in One! is fully compatible with the HP LaserJet Series II, IID, and the new HP LaserJet IIP.

Get the polished look of typeset documents with *25 Cartridges in One!* The single cartridge solution for your laser printer!



PACIFIC
DATA PRODUCTS
9125 Rehco Road, San Diego, California 92121
Tel (619) 552-0880, Fax (619) 552-0889

PACIFIC
DATA EURO LTD
48 Crown Street, Reading Berkshire RG1 2SE England
Tel (+44) 734 575727, Fax (+44) 734 591594

Circle 467 on Reader Service Card (DEALERS: 468)

custom device drivers.

MiraShading runs under Helios 1.1 on T800 transputers with the Prospero Pascal compiler for Helios. You can store objects on disk and retrieve them in binary or ASCII text format. Utility functions let you write and read vectors, integers, and characters to or from disk.

Price: 10,000 deutsche marks.

Contact: ArtTec Software GmbH, Speckerhohlweg 7, D-6240 Königstein/Ts, West Germany, 49-6174-23659.

Inquiry 934.

Network pc-Fax

Softech Communications offers pc-FaxNetwork, a network version of its pc-Fax system. The system comes in a variety of configurations, from a starter pack containing one pc-FaxNetwork card for up to five network users to a five-card pack for up to 17 high-volume users. Additional users can be added using LAN/Plus upgrade packs, which are available in one-, three-, and five-user configurations.

You can configure all packs to serve any combination of two types of user: those able to send just faxes and those able to send faxes and binary files.

For fax and file transfer communication for multiple users, you install a fax card into a selected network computer to act as a fax server. In this mode, the fax server can support up to five or more PCs on the network.

The fax server automatically queues faxes for transmission and interrogates every 10 seconds for faxes.

In the second mode, you install a fax board in an individual user's PC to provide a data transfer rate of 9600 bps for computer files (Direct Delivery File Transfer, or DDFT) over the public telephone network to similarly equipped PCs or networks, as well as direct desk-to-desk fax communication.

The system allows DDFT users to produce color as well as black-and-white text and graphics documents on their PCs and then either route them through the departmental fax server to network users or transmit them directly to other pc-Fax-equipped computers.

The system offers transmission and reception of text or graphics, text and graphics merge, conversion utilities, queuing, auto-dialing, and programmed broadcast to multiple locations.

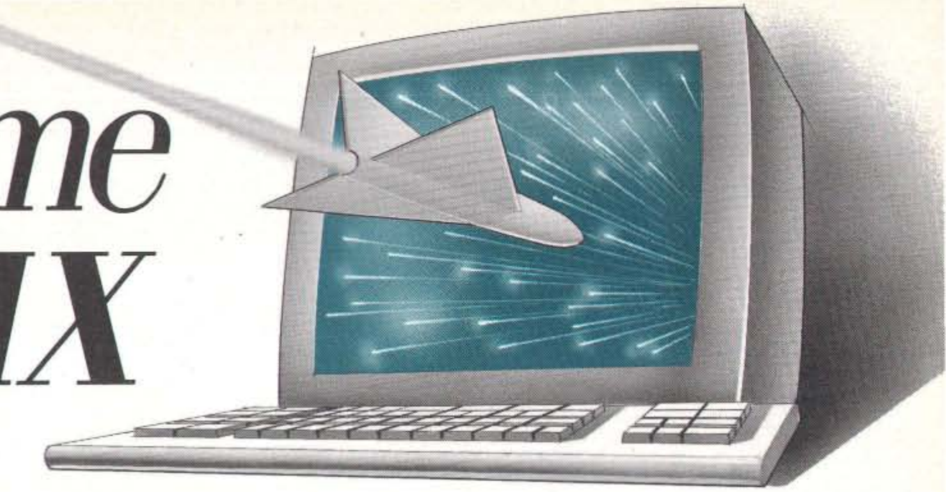
The pc-FaxNetwork system uses CCITT standard protocols as the basis for fax transmission and reception, and it uses the same protocols and error-correction standards to send and receive files. The system requires an IBM XT as the fax server, DOS 3.0, and a Novell network running under NetBIOS.

Price: £1950 for the starter pack.

Contact: Softech Communications Ltd., Unit 13, Chaucer Industrial Park, Watery Lane, Kemsing, Sevenoaks, Kent TN15 6PL, UK, 44-732-63111.

Inquiry 944.

Welcome to UNIX



APPLICATION DEVELOPMENT

ESIX System V
Includes Software Development Extensions, UNIX Operating System, X Window Support, TCP/IP, Streams, and more.

	list	our price
comp. unlmtd. ver.	825.00	**739.00**
ESIX/NFS-386	525.00	**469.00**

INTERACTIVE ARCHITECH™ Series
Buy just the software which meets your specific needs. Select from the application, network or workstation series, each with a starter, extender and developer edition.

Workstation Developer Edition*
includes everything you need, X11 dev. system, VP/ix dev. system, TCP/IP, NFS & Oper. system

	list	our price
1-2 users	1995.00	**1596.00**
3+ users	2995.00	**2396.00**

SCO Open Desktop

	list	our price
single user version	995.00	**786.00**
multi-user upgrade	1495.00	**1179.00**
Devel. System	1495.00	**1179.00**

XVT for X Windows
Developed by Advanced Programming Institute. A high-level C Library that provides a common programmer-interface across different graphical environments. Marketed by GSS.

	list	our price
Unix 386/ix	1495.00	**1349.00**

DATABASE PRODUCTS

Oracle

2-8 users	list	our price
Oracle RDBMS	3450.00	**2929.00**
SQL forms	1035.00	**879.00**
SQL plus	863.00	**735.00**
SQL ReportWriter	1035.00	**879.00**

available on ISO 386/ix, SCO Unix, AT&T

Foxbase+

	list	our price
385 Unix/Xenix	995.00	**749.00**

File Pro Plus - *Small Computer*

	list	our price
386 Unix/ Xenix	1595.00	**1349.00**

db MAN V/386 - Verasoft

	list	our price
386 Unix	995.00	**839.00**

NETWORKING AND COMMUNICATION

InterLan TCP/IP
Protocol Software Package with NP600A Protocol Processor on UTP.

	list	our price
Unix/386	1490.00	**call**

WESTERN DIGITAL

	list	our price
Ether Card Plus 16	499.00	**399.00**
Ether Card Plus	399.00	**269.00**
PS/2 Models	499.00	**399.00**

TERM-CENTURY SOFTWARE
Communication package that runs identically under different operating environments

	list	our price
Unix/Xenix 386	495.00	**395.00**
DOS	195.00	**159.00**

MULTI-USER BOARDS - ANVIL DESIGNS

	list	our price
ON board 8 port	1295.00	**call**
ON board 2 - MCA 8 port	1295.00	**call**
BRUMBRY 8port	745.00	**call**

UNIFAX - Unifax Communications
Send mail from desktop to Group 3 Fax machines worldwide. Fax publishing of troff documents and TIFF images.

	list	our price
SCO Unix, 386/ix	695.00	**539.00**

Quadram JT - FAX 9600
Internal Group 3 Fax card 9600 bps transmission. Ideal in working with UNIFAX.

	list	our price
	795.00	**595.00**

Prices subject to change. Prices in US dollars.

Programmer's Odyssey specializes in the Unix/Xenix operating environments, offering a complete line of language and development tools, database management systems, and application software *(this ad is only a partial list of our complete line)*. Our goal is to provide our customers with the tools equal to the multi-user, multi-tasking challenge of the 1990's. We offer:

- **Service to the International Market, shipping our products out daily. Next day service is available.**
- **Our hours are Monday - Friday, 9:00AM - midnight Greenwich time. (4:00AM - 7:00PM NY time)**
- **Volume Discounts.**
- **Convenient payment with MasterCard, VISA, wire transfer, or letter of credit.**
- **Dealer Inquiries Welcome.**

Within the U.S. and Canada, call toll-free 1-800-848-8731

PROGRAMMERS ODYSSEY ©

120 Hudson St., Northborough, MA 01532 USA *phone:* **(508)393-5560** *fax:* **(508)393-1456** *telex:* **430328 NEW AGE**

Circle 472 on Reader Service Card

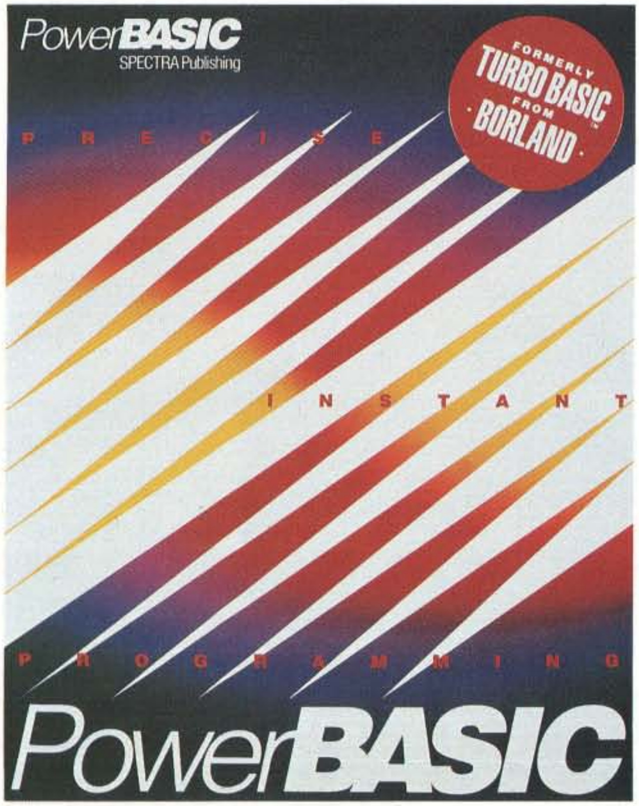
Circle 331 on Reader Service Card

IT'S FAST!
IT'S POWERFUL!
IT'S EASY!

Just Released

Turbo Basic™ just got faster and more powerful

And it's the only BASIC compiler that can figure every calculation to the exact penny!



Spectra® Publishing is pleased to announce the release of PowerBASIC™ 2.0 (formerly Turbo Basic™ published by Borland International)

Along with enhanced speed, a new user interface, context sensitive help screens and an excellent new debugger, several features have been added to make PowerBASIC™ both easy and powerful to use:

* Fixed point and floating point decimal BCD variables
* New, procedural math package is *fast* without 8087
* Use all available memory: string space not limited to 64K
* User defined dynamic data structures
* New data types (extended-precision (80 bit) float, quad-word (64 bit) integers, as well as flex strings)
* Built-in ARRAY SORT, ARRAY SCAN, ARRAY INSERT, and ARRAY DELETE
* Modular compilation and object linker
* Integrated debugging environment
* Online help screens

PowerBASIC™ provides a complete development environment; an integrated editor, debugger, compiler and linker, as well as command line version for batch mode operation.
PowerBASIC™ Suggested Retail Price: **US $129.00**
PowerBASIC™ upgrade policy: **US $59.00 plus US $35.00 shipping and handling.**
(Turbo Basic serial number required to receive upgrade pricing.)

A shipping and handling charge of US $35.00 will be added to all international orders.
Available in 5 1/4" or 3 1/2". PowerBASIC is a registered trademark of SPECTRA Publishing. SPECTRA Publishing is a division of PC-SIG Inc. Turbo Basic is a registered trademark of Borland International. IBM is a registered trademark of IBM Corporation.

SPECTRA Publishing Inc., Sunnyvale, CA 94086 USA,
(408) 730-9291, FAX (408) 730-2107

Circle 334 on Reader Service Card

☐ **YES,** I would like to order PowerBASIC™ for US $129.00 Shipping and handling US $35.00.

☐ **YES,** I want to upgrade from Turbo Basic™ to PowerBASIC™ for US $ 59.00, plus US $35.00 shipping and handling. *(Turbo Basic serial number required)*

Turbo Basic serial number: ____________

PowerBASIC™ Ver. 2.0 for IBM and compatibles:

☐ 5¼" ☐ 3½"

Mr. / Ms. / Miss / Mrs. / Dr. (please circle)

Name ____________

Address ____________

City ____________

Country ____________ Postal Code ____________

Daytime Phone ( ) ____________

Payment by: *(no purchase orders or COD, please)*

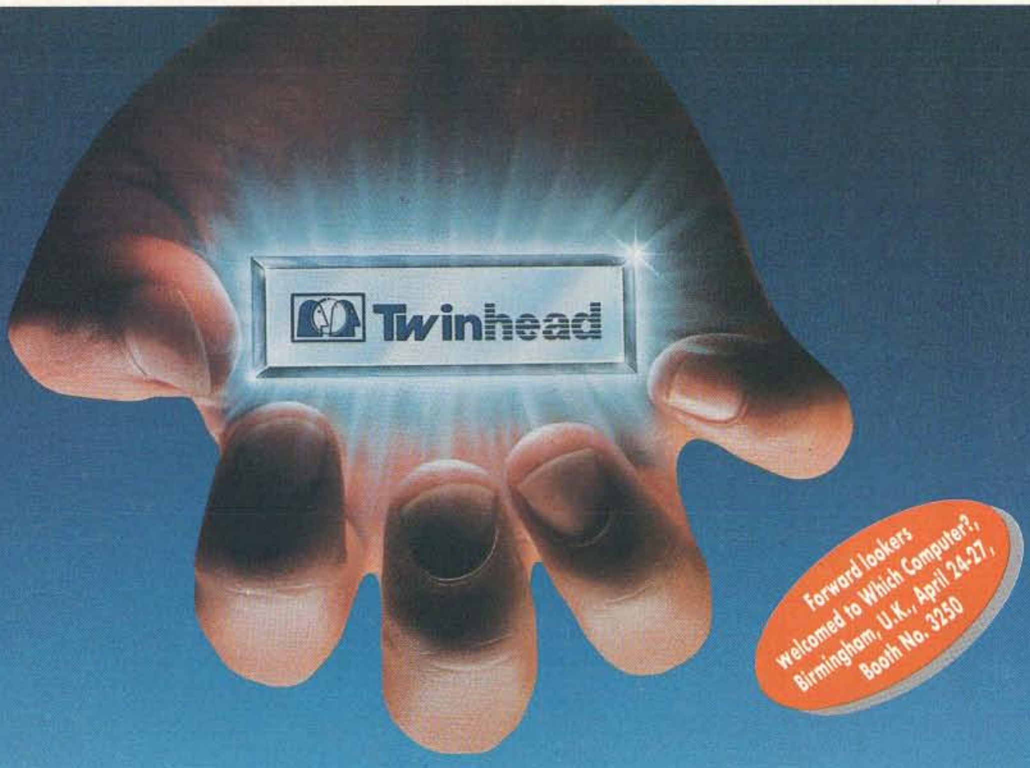
☐ Money Order *(US Funds)* ☐ VISA ☐ MasterCard

Card No. ____________ Exp. Date ____________

Signature ____________

Mail to: **SPECTRA® Publishing**
BYTE
McGraw-Hill Information Services
McGraw-Hill House
Shopenhangers Road
Maidenhead, Berkshire SL6 2QL
England
Attn: Barbara Copcutt,
International Circulation

#4025



GRASP THE FUTURE

The road ahead is 32-bits wide, and Twinhead has the map

Superlap

A portable handful of power and performance. Features 386SX, RAM up to 4MB, FDD and HDD, VGA graphics with 32 greys, 640×480 page-white LCD, 83-key detachable keyboard with embedded keypad. Ports include 2 serial, 1 parallel, external monitor/disk drive/keyboard/keypad, expansion bus, and interface for an internal modem. Using AC power or NiCad battery, Superlap gives you 32-bit power on the move.

Superset-600

A compact platform for fast 386 or 486 processing. The basic 600 (386-25MHz) is slotted for simple Power Card upgrades. Power Cards supply CPU (386-25 /33, 486-25/33), 64KB cache, and cache controller. All-in-One design integrates VGA, parallel and 2 serial ports, and drive controllers on mainboard. Storage for 2 × FDDs, 3.5″ HDD, and 5.25″ Tape/HDD. Superset-600 is your bridge to the future.

Staying abreast of everchanging technology is critical. Twinhead has an unparalleled record of engineering the latest ideas into reliable, affordable systems. Take the future in hand, see Twinhead's new 32-bit models. Your systems for the nineties.

Twinhead

Engineering Ingenuity

Global Industrial Center
2nd Floor, 2 Lane 235,
Bao Chiao Road,
Hsin Tien, Taiwan, R.O.C.
TEL: (886-2) 917-9036 FAX: (886-2) 917-2675

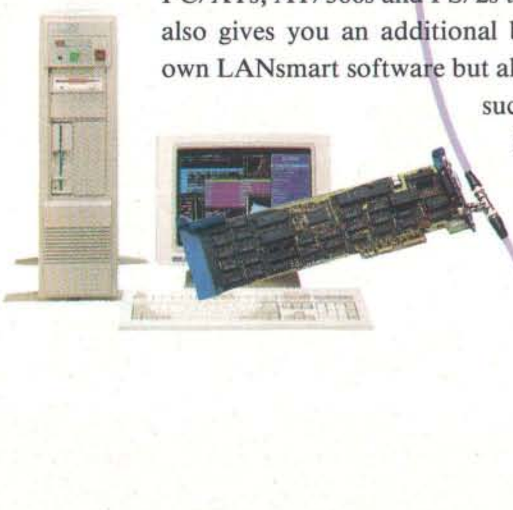
Trademark Recognition:
Intel Corp.: 80386, 80486, 80386SX
International Business Machines Corp.: VGA
Twinhead International Corp.: Superlap, Superset-600

Circle 332 on Reader Service Card

Why we developed a network for small business?

Unlike other LANs that try to make a sale out of complexity in the name of technical excellence, D-Link gives you the practical solution with product quality and solid performance that you can afford. Take our D-Link LANsmart network operating system software, for example. Its DOS and NetBIOS compatibility gets you right away into information/peripheral sharing with all existing applications available in the market. Its easy operating and flexible configuration features make it ideal for any small business that cannot afford the expenses of constant professional support and dedicated server computers.

From Ethernet to ARCnet to our own twisted-pair network, D-Link gives you the one-stop shopping convenience to select hardware to fit your specific requirements of networking PC/XTs, AT/386s and PS/2s together. All D-Link hardware also gives you an additional benefit: it not only runs our own LANsmart software but also is fully compatible with other major LANs, such as Novell's NetWare. Which makes your investment on D-Link even more valuable and long-lasting.



So if you think of a network for small business, think of D-Link.

D-Link®
the easy link

Head Office
D-Link Systems Inc.
5 Musik
Irvine, CA 92718
TEL: (714) 455-1688
FAX: (714) 455-2521

D-Link (UK) 01-209 1300
West Germany 09131-22553
France 086-914416
Italy 0733-586423
Spain 93 3233151

Portugal 02-9487514
Switzerland 032-410111
Belgium 03-4803797
Sweden 040 164180
Finland 0-5653811

CHAOS MANOR AWARDS

Jerry presents his annual awards for the best products of 1989

Well, it's year's end and time for the annual Chaos Manor Awards. Of course, this is the April issue, but there's no help for that; by me, a year ends in December when I write this column.

First the ground rules: these are *my* awards. This year for the first time we'll be giving out certificates—the basic design was done by Mrs. Pournelle with considerable help from the BYTE editorial staff—that bear the BYTE logo; what that means is that BYTE approves of my giving awards; however, they remain *my* choices, not those of the BYTE staff.

There are two award categories: the Chaos Manor Best of the Year User's Awards, which go to products that I consider the best in their respective categories *and that are in use at Chaos Manor*, and the Chaos Manor User's Choice Awards. In both cases, the awards go to products I use myself.

In addition to the awards, there's the Chaos Manor Orchid and Onion Parade for products, companies, and deeds that I think deserve praise or opprobrium.

Languages

I have for years said that small computers will come of age when programming languages are at the point where programming skill, per se, isn't as important as the ability to think up things for the machines to do. I tend to look for developments that move us in that direction.

One of those is object-oriented programming, of which a prime example is Borland's Turbo Pascal 5.5, which provides the simplest introduction to OOP that I know of. I've said enough about Turbo Pascal that I needn't repeat it here; I really had no trouble deciding that Turbo Pascal 5.5 has earned the Language of the Year User's Choice Award.

I have to add that it was not the only significant user-oriented language development last year. It had two very serious competitors. One of them, Microsoft BASIC 7.0 Professional Development System, didn't get here until mid-December, and while that's technically in 1989, it hasn't been around long enough to be in this year's running. However, I have had it long enough to know I like it.

BASIC 7.0 is revised BASCOM with a world of new features. It's thoroughly integrated with CodeView, the Microsoft debugger. My late mad friend Dan MacLean really hated BASIC as a programming language because of its lack of structure, but I'm sure he'd share my enthusiasm for the new BASIC 7.0. He would, however, insist that it isn't really BASIC. BASIC in his day required line numbers, had few control structures and no declarations, and generally required liberal use of GOTO statements to build useful programs. Now, not one of those criticisms applies.

Microsoft's BASIC 7.0 compiler has a lot of interesting features. For one thing, it breaks the 64K-byte string space limit. For another, it can automatically use EMS memory, which means that on a 386 with a memory manager such as Quarterdeck's QEMM-386, you can have very large programs without kludges. There are already several commercial games that are written in compiled BASIC; now there will be even more. Microsoft BASIC 7.0 looks very good indeed as a language for developing large and complex programs quickly and easily.

There's a significant development in the other direction, as well. I described Crescent's P.D.Q. library for Microsoft QuickBASIC 4.5 in the February column: with P.D.Q., you can build small, fast programs in BASIC, including TSR programs; P.D.Q. has already earned its User's Choice Award. Equally important, Crescent is revising their entire line of professional BASIC tools and routines to work with the new Microsoft BASIC 7.0; those should be out by the time you read this. The result is a truly professional capability that provides a highly friendly and productive environment.

Microsoft and Crescent have taken several giant steps toward the world I envisioned 10 years ago, in which anyone could write and debug decent programs. A world in which you concentrate on what you want the computer to do, rather than how to persuade it to do it. True, behind that kind of "user programming" there have to be some very sophisticated people writing software tools in assembly language—which is fine by me. I don't really know how my books are printed and bound, either.

Follow the Dots...

When I got old Ezekial, my first computer, about half the cost was for a Diablo daisy-wheel printer. Later I upgraded to an NEC Spinwriter. It's faster than the Diablo and uses a thimble rather than a daisy wheel, but otherwise it's not a lot different from the old Diablo: big, clunky, loud, and pretty slow.

I solved the whole problem by going to the Hewlett-Packard LaserJet; I got one of the very first ones, and I loved it. I'm told my raving about the thing helped HP's sales a lot, and I sure hope so. Incidentally, I still have it and still use it. It was upgraded to a LaserJet Plus, but that's the only service or maintenance it ever got, and it will be used to print out this column when I'm done.

I do use the old NEC Spinwriter once a month: when it comes time for the ritual known as The Paying of the Bills. I have an accounting program (I wrote it) that lets me enter the checks and credit-card expenditures and such into my General Journal; after which another program reads the Journal and writes the checks. The checks themselves come printed on

continued

tractor-feed paper, so there's no way they can be fed into the LaserJet. As a consequence, every month I drag the Spinwriter out of a closet and fire it up for the half hour it takes to write checks, and then I stuff it away again.

Then last fall I met someone from the printer division of Seikosha. "I need a little printer," I said. "The smallest tractor-feed printer you have."

"That's no problem," he said, making a note, "but don't you want a *real* dot-matrix printer as well?"

I'd never thought about it; what I really wanted was freedom from the Spinwriter. Still, Don Hawthorne, our writer apprentice at Chaos Manor, lives out back in the old apartment suite, and when he needs to print, he has to bring in a disk. That sounded like a fair test to Seikosha, and a few days later there arrived two Seikosha printers: a perfectly wee little thing called the SP-2000, which weighs under 8 pounds and is about as small as anything incorporating a tractor feed could be, and the SL-230AI, which is about 25 pounds and fully as large as the NEC Spinwriter.

These arrived when I was about to go off on a trip. I didn't even open the SL-230AI; I just pointed Don Hawthorne at it, handed him a printer cable, and told him to see if he could get it running with his Tandon AT compatible. It seemed a fair test: Don has much experience as a copy editor and proofreader, and he knows a good bit about typography and typesetting; but his hands-on experience with small computers is almost nil.

Don has used that printer to print out and sell enough stories that it's not really accurate to call him an apprentice any longer. He got the printer to work with Q&A and a roll of Avery labels to make up the labels for our Christmas greetings list; he does a good bit of my correspondence with it; and in general, he uses the printer daily. No glitches.

Dot-matrix printers have come a long way in the past few years. The SL-230AI is fast and relatively quiet, and best of all, the output doesn't look like dot matrix. Italic is *italic*, boldface comes out **boldface**, and so forth. They're quieter, too, not much louder than most office equipment.

I still prefer laser printers for both speed and print quality, but I have to say, modern dot-matrix printers are plenty good enough. Incidentally, hooking up the SP-2000 so it would do the NEC Spinwriter's job took about 5 minutes; and it sure takes up a lot less room. Now my only problem is, what do I do with an old NEC Spinwriter?

Clearly, the Seikosha dot-matrix printers have earned their User's Choice Award.

UPS of the Year

Ever since the Great Power Spike (see my August 1989 column), I have been sensitized to the need for power conditioning; in fact, not only have I had all my systems connected to surge protectors, but my major systems are connected to uninterruptible power supplies, usually called UPSes.

I have come to the conclusion that if you are serious about the value of the work you do on your small computer, you simply must get a UPS; it's as important as backing up your hard disk. If you run Unix, it's even more important, because Unix talks to the disk from time to time even if you're not around, and if

continued

Erasable Optical Or Write-Once,

The Right Ones Are Right Here.

Today, there are important places for both erasable and write-once optical storage. But Storage Dimensions is the *one* place to find the right optical solution for you. Erasable *and* write-once. Plug-and-play. For every popular PC environment—DOS, Macintosh® and Novell®

Applications such as image management, database distribution and back-up are naturals for high performance erasable optical storage. It's no coincidence that our new LaserStor™ Erasable Optical subsystem, with its nearly one gigabyte cartridge capacity and 35 ms average seek time, is *the* industry performance standard.

For archiving, document storage/retrieval and microform replacement, write-once optical clearly makes the most sense. And the clear winner again is LaserStor, the number one desktop seller. That position will only get stronger with our newest write-once offerings. First, a 940-megabyte subsystem that combines high capacity with impressively high-speed throughput. And second, our compact, internally mountable half-high, 786-megabyte package.

LS800H Half High, With Host Adapter.

The right optical products—Erasable and Write-Once—are right here, right now. So give us a call, right now. 408/879-0300. Storage Dimensions, 2145 Hamilton Avenue, San Jose, CA 95125.

STORAGE DIMENSIONS

Call me, I'm interested; circle 270

Please send literature; circle 271

B-LS1

there's a power glitch while Unix is doing whatever mysterious things it does, you can lose *everything*.

Anyway, we've been collecting and testing UPS systems for several months now. Naturally, the only kind I'd even consider testing do power conditioning as well as provide emergency power. That eliminated several. Some we tried didn't work properly. I'd plug the Zenith Z-248 (286) computer into the UPS, get Q&A Write going, and yank the UPS power cord. If the computer had any problems at all, that UPS went back to its manufacturer. Then I plugged the UPS into a Variac and ran the voltage down; if the UPS didn't kick in before the computer noticed, we got rid of it. That got rid of a *lot* more UPS boxes.

Eventually we were down to just two brands of UPS. Both had come through the initial tests all right.

One surviving UPS is a small desktop unit, a cute little thing with convenient switches and flashing lights, a lot prettier than its Clary competition. It's also quieter; the Clary desktop UPS has a fan sound squarely in a frequency I'm sensitive to. Mind you, that's not a real flaw for most people; I have a condition commonly known as "artillery man's ear," which means serious hearing losses in scattered frequencies, no losses at all in others. The result is that I don't hear my own voice very well, and many conclude I'm deaf as a post; but in fact I hear high frequencies better than most people, so that things that sound normal or quiet to my friends are sometimes loud to me.

In any event, I chose the Brand X UPS (I don't name it for reasons I'll give later) to sit on my desk, and Don Hawthorne got the little desktop Clary, which, incidentally, he loves, but that's getting ahead of the story.

I plugged Big Cheetah, a 386/387 with a Distributed Processing Technology disk drive controller, a Priam 330-megabyte hard disk drive, and 4 MB of memory, into the UPS. I plugged in the Zenith Flat Technology Monitor (FTM). Then into the outlet labeled "printer" I plugged in a four-outlet box, into which I plugged the USRobotics modem, a CD-ROM drive, and the Maximum Storage WORM (write once, read many times) drive. That's three items, leaving the fourth outlet on the strip empty. The UPS fired up, and everything seemed to be working properly.

It was that way for weeks; then one day the housekeeper plugged a vacuum cleaner into that empty fourth outlet on the power strip. For about 2 minutes nothing happened; then, Whammo!, the system sounded horrible warnings, and everything shut down. Clearly, overloading that UPS was *not* the thing to do. I unplugged the vacuum cleaner and restarted. Nothing. A glass cartridge fuse had blown, and until it was replaced, the UPS was dead. Once the fuse was replaced, everything seemed all right—

Until a couple of weeks ago. We've been having rain in Los Angeles. Rain does odd things here. Power spikes. Miniblackouts in which lights flicker. And every time the lights flickered, Big Cheetah reset. He came right back up OK, but he had *reset*. Fortunately, my habit is to save early and often, so nothing was lost; but this clearly was not why you want a UPS!

Time for some investigation. I had Don Hawthorne bring the little Clary UPS from his room and plugged Big Cheetah into it.

The Clary UPS has fewer switches and

continued

Series 4 Assemblers/Simulators/Compilers

Assembler:
Full listing control, conditional assembly and built-in cross-referencing. User-defined sections. Linker & Librarian. Listings can be relocated by the Linker to reflect actual run-time addresses.

Outputs:
IntelHex, Extended IntelHex, Motorola s19, s28 and s37 file formats. Supports the most commonly used symbol table formats.

Simulator-Debugger:
Address, memory and register breakpoints with optional pass count. Read/write and write-only memory trapping. Single step, trace, undo, and multiple scrollable hex windows. Supports all symbol table and file formats output by 2500 A.D. Linker.

Compiler:
Supports in-line assembly language, ROM-able code and full floating point. Includes Macro Preprocessor, Assembler, Linker, Librarian, C and Assembly Libraries, and Simulator-Debugger (except Z280 & 68020). C-Library source extra.

Memory:
Series 4 products require a 640K MSDOS system.

	All products are available for MSDOS, OS/2 and XENIX			
Processor	**Macro Assemblers**	**Simulator-Debuggers**	**C Compilers**	**Library Source**
Super 8	200.00	150.00	600.00	250.00
Z-8	200.00	150.00	600.00	250.00
Z-80	200.00	150.00	600.00	250.00
Z-280	300.00		500.00	250.00
Z-8000	300.00			
1802	200.00			
6301	200.00	150.00	600.00	250.00
64180	200.00	150.00	600.00	250.00
6501/02/C02	200.00	150.00		
65816	300.00			
6800,2,8	200.00	150.00		
6801,3	200.00	150.00	600.00	250.00
6804	200.00			
6805	200.00	150.00		
6809	200.00	150.00	600.00	250.00
68C11	200.00	150.00	600.00	250.00
68000,8,10	300.00	200.00	700.00	250.00
68020	400.00		600.00	250.00
8400/C00	200.00			
8044/51/52	200.00	150.00	600.00	250.00
80410/710	200.00	150.00	600.00	250.00
80451	200.00	150.00	600.00	250.00
80515	200.00	150.00	600.00	250.00
8080	200.00	150.00		
8085	200.00	150.00		
8086/88	100.00			
8096	200.00			
80186/286	200.00			
80386	300.00			
8748	200.00	150.00		
87751	200.00			
740	200.00			
NSC800	200.00	150.00	600.00	250.00
PDP-II	300.00			

Name ______________________ (Please Print)
Company ______________________
Address ______________________
City ____________ State ______ Zip ______
Phone ______________________

Product ____________ Operating System ____________
Series ____________ Amount $ ____________
Shipping $ ____________ Total $ ____________
Signature ______________________
Check ☐ COD (U.S. Only) ☐
MC/VISA/AMEX # ______________________
Expiration Date ______________________

Educational discount available.
To order, call toll free in U.S. (including HI, PR and VI):

1 800 843-8144

In Colorado: (719) 395-8683
TELEX: 752659/AD FAX: (719) 395-8206
For more details, ask for a free brochure.
(Shipping is $31.00 per unit for overseas orders. Toll Free number does not apply to overseas. 2500AD pays COD charges.)
Circle 8 on Reader Service Card

2500AD SOFTWARE INC.
109 Brookdale Avenue
P.O. Box 480
Buena Vista, Colorado 81211

controls than the other one does; but it also has one thing the others lack, a line of lights, first green, then red. As you draw more current from the UPS, more and more of the green lights come on, until you overload it, and you get one green and one red; then, no green and two red, at which point it simply cuts things off and tells you in no uncertain terms that you can't overload it this way.

It did that with Big Cheetah. The interesting part is that it is rated for as much power as the UPS I'd been using on Big Cheetah—which *let me use it* but wasn't reliable. The Clary UPS, in other words, knew it was overloaded and was not about to fool me into thinking it was doing its job when it wasn't.

"You've had your Tandon 286 plugged into this Clary during the bad weather, haven't you?" I asked Hawthorne.

"Sure have. Never noticed a thing."

"Even when the lights blinked?"

"Nothing. I remember once I was writing and I'd just finished something and was saving it when the lights blinked. The Clary box screamed for a second, but then the lights came on, and no problem. I just went on working."

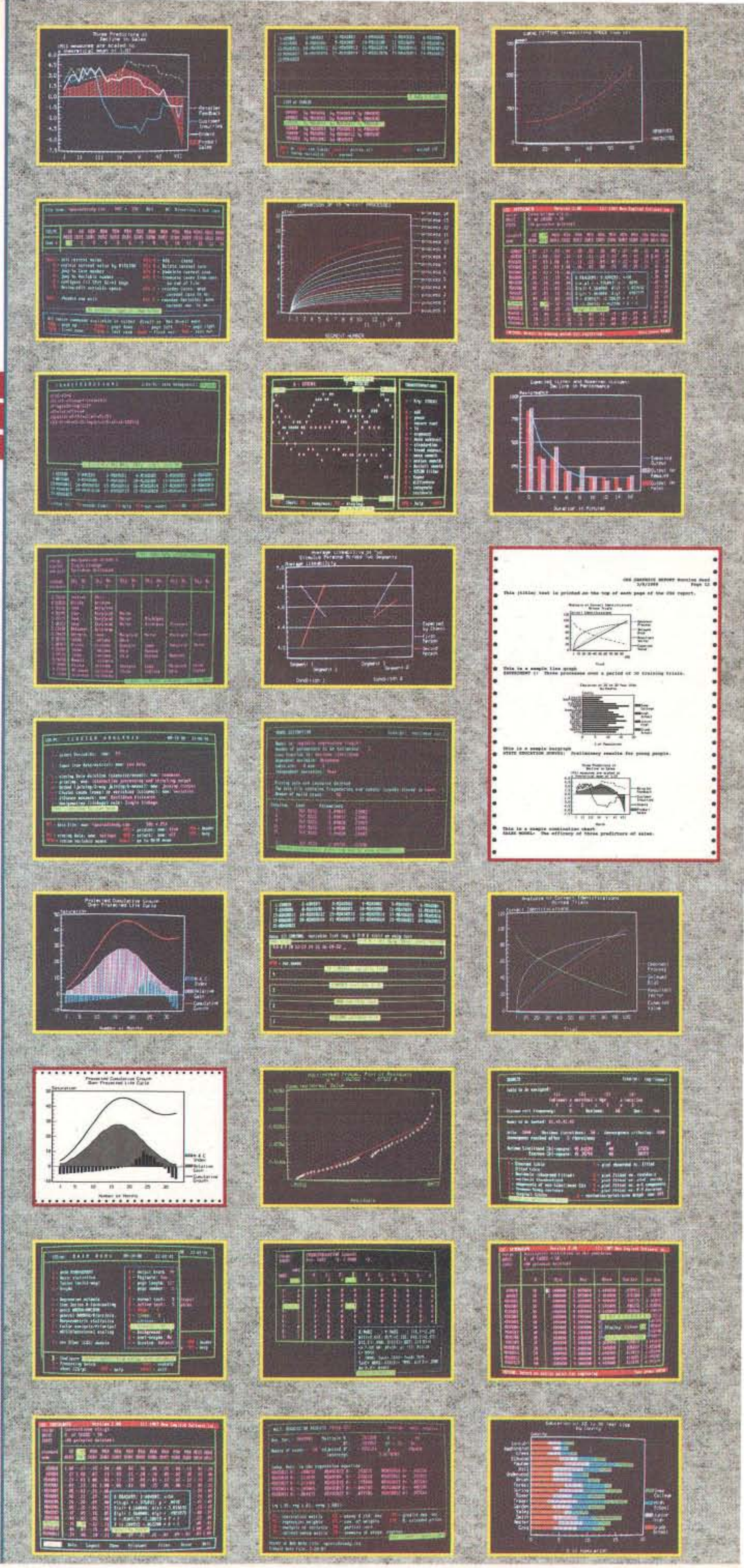
He just went on working, while Big Cheetah, supposedly protected by the other UPS, reset itself.

So, as I write this it's raining outside, and I have a lash-up. Big Cheetah is still plugged into the other UPS, but *that* is plugged into a big, hairy extension cord, which runs across the Great Hall to the soundproofed electronics closet; and in that closet the big extension cord is plugged into the *big* Clary UPS, their 1.25-kVA OnGuard system. As I wrote this, I deliberately did *not* save the last paragraph.

I walked over to that closet and yanked the cord that plugs the Clary UPS into the wall. It howled. I waited a moment and plugged it back in. Then I stood there and *jiggled* the plug, plugging it in and out as fast as I could about nine times. Came back here. As you see, the paragraph remains intact. Things plugged into a Clary UPS never know that you're torturing the poor thing.

The Clary 1.25-kVA UPS is in a closet because it is much louder than its little brother; it puts out a high-pitched sound that even my wife finds too much to be close to. That's all right. It doesn't need attending, and we'll never hear it in the cable closet. It would be all right in almost any kind of cabinet for that matter, but it's pretty big, and it's convenient to have it remotely located. Tomorrow, I'll string a power cable under the floor.

continued



As to why the other UPS is still on my desk, I have deadlines and it's a perfectly good power-distribution box. Besides, the monitor is sitting on it and I like the height. I'll change that tomorrow, too. I don't name this box because it's a perfectly good UPS if you don't overload it. After all, it did pass my preliminary tests. Its only real problem is that it doesn't tell you when it's overloaded.

But the clear winner of the Chaos Manor UPS of the Year User's Award is Clary. I have no hesitation in trusting my work to Clary.

Dance of the Planets

There isn't much science education software, and a lot of it isn't very good, which is surprising, since computers are getting faster and their graphics better. Once in a while, though, comes a program that will simply blow you away.

Dance of the Planets is like that. It has an infuriating user interface that's hard to learn unless you know a lot about astronomy. The view it gives you when you first fire it up isn't very intuitive. Even after you use it for a while, it will do things you didn't expect, and you'll have vexing problems trying to get it to do something simple. But none of that matters at all.

Dance of the Planets simulates the solar system. Once you've mastered it, you can move around from one viewpoint to another. Stand well back and watch all the planets go about the Sun. Set a date, past or future, to see where the planets are. Add the asteroids, and look again. This part of the program alone makes it an absolute *must* for me: I have several science fiction stories set in the asteroid belt, and it used to drive me nuts calculating where the various flying mountains were relative to each other and to the major planets. Now I just crank up Dance of the Planets.

Once you've looked at the solar system, zoom in on a planet, Jupiter, for instance, and see all the moons, plus the great bands on Jupiter itself. Now go look at Saturn as it appeared from *Voyager*. And on. It's not the easiest program to learn, but it's sure worth learning it.

Dance of the Planets works on EGA systems, but it's prettier on VGA. We've had it up on a Tecmar VGA card with a Zenith FTM, and a Samna VGA card with the 19-inch Electrohome monitor; you haven't lived until you've seen Saturn's rings on a 19-inch color monitor! A fast 386 with no coprocessor will run it fairly well, but a slower 286 with an 80287 math chip will be faster: this is a simulation program, and it has to calculate where all those objects are. A 33-MHz 386 with an 80387 really screams.

If you have the slightest interest in astronomy and the solar system, get this program, which I'm giving the Best Science Education Program of the Year User's Choice Award. Try it. You will love it.

Games

There are two kinds of games: those that you think you *ought* to enjoy, and those you just plain like. Chess falls in class 1 for me: I used to be a good chess player and even played successfully for money when I was in the army. I still follow the tournaments, and I guess I still think of myself as a chess player; but the fact is that I haven't played much in the past few years. I'm not sure why.

But, if I do play chess against a computer, the game to beat is Chessmaster 2100 from The Software Toolworks,

continued

LET'S GET RIGHT TO THE POINT.

The point is: today's applications require a great pointing device. PC-TRAC™, our newest advanced-design trackball, gives you precision control over every move your cursor makes. Without cramping your desk, your style or your hand.

Click with your thumb or fingertips on PC-TRAC's wrap-around buttons. They're easy to locate and unexcelled on response, with built-in drag lock.

PC-TRAC is the most comfortable pointing device you'll ever lay a hand on. Relax your entire hand, while your fingertips master the power of touch with incredible ease. Control the ball and buttons with your fingertips. If mice ever made you feel like you're all thumbs, wait till you try PC-TRAC.

Any way you use PC-TRAC, you're on a roll with more agility, more precision, and resolution up to 1,000 dpi—automatically. And since the trackball gives you direct fingertip control, there's never any mouse cursor creep.

PC-TRAC fits beside your keyboard in less than 4 inches. And, unlike a mouse, it stays put in one spot. PC-TRAC gives you back the desk space your mouse and mouse pad took away from you. Now no mouse pad, no mouse rowing, no mouse cleaning.

Just plug PC-TRAC in and perform. Minimal set up. No waiting. PC-TRAC is 100% Microsoft® Mouse or PS/2® Mouse compatible. For Lotus®, dBASE®, or WordPerfect® use the included software utilities that come in the box.

PC-TRAC. A great pointer. Check it out for performance, style and an unbeatable price.

PC-TRAC available in Serial, Bus, PS/2 and InPort™ versions. Suggested Retail Price $119, bus version slightly higher.

MICROSPEED
1-800-232-7888
International and California call (415) 490-1403 FAX (415) 490-1665

Circle 188 on Reader Service Card (DEALERS: 189)

ITEMS DISCUSSED

APX-5200 .... $3575
Maximum Storage
5025 Centennial Blvd.
Colorado Springs, CO 80919
(719) 531-6888
Inquiry 991.

Chessmaster 2100 .... $49.95
The Software Toolworks
19808 Nordhoff Place
Chatsworth, CA 91311
(818) 886-5912
Inquiry 992.

Courier HST Dual Standard... $1595
USRobotics, Inc.
8100 North McCormick Blvd.
Skokie, IL 60076
(708) 982-5010
Inquiry 993.

Dance of the Planets 1.5...........$195
A.R.C. Software
P.O. Box 1974
Loveland, CO 80539
(303) 663-3223
Inquiry 994.

Macintosh IIx $5269
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 995.

Microsoft BASIC 7.0...............$495
Microsoft Mouse....................$150
Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(800) 426-9400
(206) 882-8080
Inquiry 996.

Nemesis, the Go Master........... $79
Toyogo, Inc.
76 Bedford St., Suite 34
Lexington, MA 02173
(617) 861-0488
Inquiry 997.

Onguard PC-1.25k UPS $2390
Clary Corp.
320 West Clary Ave.
San Gabriel, CA 91776
(818) 287-6111
Inquiry 998.

Palindrome
80 megabytes .... $1295–$1595
150 megabytes .... $2295–$2695
2.2 gigabytes............ $7995–$8095
Palindrome Corp.
850 East Diehl Rd.
Naperville, IL 60563
(708) 505-3300
Inquiry 1000.

Paper White VGA Monochrome Monitor................................$199
Goldstar Technology, Inc.
3003 North First St.
San Jose, CA 95134
(408) 432-1331
Inquiry 1001.

P.D.Q. $99
Crescent Software
11 Grandview Ave.
Stamford, CT 06905
(203) 846-2500
Inquiry 999.

Premier 9000 .... $5895
Premier Innovations, Inc.
10310 Harwin Dr.
Houston, TX 77036
(800) 347-1777
(713) 995-4433
Inquiry 1002.

SL-230AI........................... $1149
SP-2000 ....$329
Seikosha America, Inc.
10 Industrial Ave.
Mahwah, NJ 07430
(800) 338-2609
(201) 327-7227
Inquiry 1003.

Spectre GCR $299.95
Gadgets by Small
40 West Littleton Blvd., Suite 210–211
Littleton, CO 80120
(303) 791-6098
Inquiry 1004.

Sword of Aragon.................$39.95
Strategic Simulations, Inc.
675 Almanor Ave.
Sunnyvale, CA 94086
(408) 737-6800
Inquiry 1005.

Turbo Pascal 5.5 ....$149.95
Borland International, Inc.
1800 Green Hills Rd.
Scotts Valley, CA 95066
(408) 438-8400
Inquiry 1006.

only I don't win very often. Old-time readers will remember that The Software Toolworks was Walt Bilofsky's company distributing really nifty utility programs in ZipLoc bags back in S-100 CP/M days. The company has gotten a bit larger, and the packaging is slicker nowadays. There's been no drop in quality of products, either. Chessmaster 2100 is as good as chess programs come.

Go is intermediate between the games I think I ought to like and the games I like. I play more go than I play chess, and I like it more; indeed, if I were condemned to play only one game for the rest of my life, I'd choose either contract bridge or go, depending on who I'd get in my bridge foursome.

There are two major go programs: Cosmo Go and Nemesis, the Go Master. Both are awfully good, and each has beaten the other in a computer go tournament. I believe that Nemesis is ahead this month. Overall it's hard to choose between them, but I find that when I play go against a computer, I almost always choose Nemesis, which tells me something. There are versions for both the Macintosh and the PC. I generally play on the Mac, but I keep the PC version on my Zenith 286 SupersPort laptop.

Finally, there's a game of no redeeming social value at all; it was just plain *fun*, and I played a lot of it last year: Sword of Aragon from Strategic Simulations. This is a game of medieval fantasy. The fantasy elements are good, but that's not what I really liked about this game. What I really liked was that you could quite realistically simulate medieval warfare, build combined-arms armies and use them properly, and win the game without letting magic dominate it at all.

Anyway, on reflection, I'm giving

continued

Can your compiler meet the challenge?

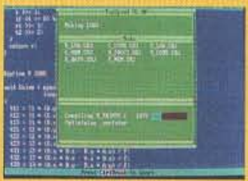
We invite you to take an existing program and compile it using TopSpeed C. Then, compare the overall performance with the compiler you now use. If you are not 100% satisfied, return the entire package to us, and we will refund all of your money.

	TopSpeed® C Version 1.00	Microsoft® C Version 5.1	Turbo C® Version 2.0	Watcom® C Version 7.0
100% ANSI compatible*	✓			
Integrated environment	✓		✓	
Pass parameters in registers	✓			✓
Expand any function as inline code	✓			
Supports OS/2	✓	✓		
DOS Dynamic Link Libraries *(overlay code linked at load-time)*	✓			
Smart linking *(only referenced code and data linked into .EXE)*	✓			
Type-safe linking *(function parameters and memory model checked at link-time)*	✓			
Fully automatic make works across libraries	✓			
Time-sliced scheduler for multi-tasking under DOS	✓			
Short pointers in any segment	✓			
Hypertext help with library online	✓		✓	

**Written by Neil Martin of the British Standards Institution (BSI) and printed in Personal Computer World June 1989 page 241*

TopSpeed®

TopSpeed's seamlessly integrated multi-windowed environment.



VID (Visual Interactive Debugger): a source-level, multi-windowed symbolic debugger.

In England & Europe contact:
Jensen & Partners UK Ltd.
63 Clerkenwell Road
London EC1M 5NP
Phone: (01)253-4333
Fax: (01)251-1442

C Standard Edition £149;
C Extended Edition £295;
C OS/2 Edition £370.

Call on handling & VAT charges, and TopSpeed Modula-2 product prices.

Standard Edition—
Optimizing DOS compiler, integrated source-level debugger, smart linker, automatic make, complete ANSI library, 6 memory models, BGI Interface, time-sliced scheduler, MS-DOS/BIOS interface, superset of MS and Turbo C libraries, and more.

Extended Edition—
Standard Edition plus full source code to libraries, post-mortem debugging, MS Windows support, support for DOS DLLs (overlays), assembler, disassembler, profiler, DOS call monitor, and more.

OS/2 Edition—
Extended Edition (except for DOS compiler) plus ability to generate DOS executables, full support of OS/2 Kernel & PM calls, OS/2 smart linker, fully automatic generation of DLLs, source for protected mode libraries, and more.

Benchmarks measured by Mark Hamilton, November 24, 1989. Copyright © 1989, PC Business World and CW Communications Ltd.

TopSpeed C:

Standard Edition $199
(DOS Compiler & VID)
Extended Edition $395
OS/2 Edition $495

64-page TopSpeed C Technical Specifications booklet available upon request

Call on TopSpeed Modula-2 compiler (with objects) & toolkits.

To Order:

In the U.S., call:
1-800-543-5202
In Canada, call:
1-800-543-8452

Call on shipping & handling charges & volume discounts. VISA/MC accepted.

30-day unconditional money-back guarantee.

C

Jensen & Partners International

1101 San Antonio Road, Ste. 301
Mountain View, CA 94043
Phone: (415) 967-3200
Fax: (415) 967-3288

Chaos Manor User's Choice Awards to Chessmaster 2100 and Nemesis, the Go Master; but the 1989 Chaos Manor Game of the Year User's Award goes to Sword of Aragon.

Monitors
The all-around best monitor in the business is Zenith's FTM, which has already got plenty of awards, including mine as monitor of the year two years running. It's crisp and clean and has no flicker. You can see it in all conditions of ambient light, from late night with other lights in the room to a bright, sunny afternoon with a window behind you. It's the monitor of choice for VGA systems.

However, it's also big, bulky, and comparatively expensive. Moreover, some people don't need color. I'll argue that if you can possibly afford it, the Zenith FTM is worth the money in what it saves you in eyestrain, even if you use it only as a monochrome monitor; but I also know that some won't agree.

We've looked into a lot of low-cost monitors this year, and one was outstanding: the Goldstar Paper White VGA Monochrome Monitor. It's about as low in cost as you'll find for anything of decent quality. It has crisp, clear images and no flicker. It's light in weight and cool-running. I used monochrome for years before I thought color was sharp enough to stare at all day; and the monitor I had then wasn't anywhere near as good as the Goldstar Paper White VGA monitor, which gets a Chaos Manor User's Choice Award.

Backup System
A lot of people seem to think that when I say something is "good enough" I am damning it with faint praise. Not so. In my judgment, "good enough" is high praise: it means I can use it without worrying about it; that it has all the features I need to get the job done.

There's one problem with starting off with hardware or software systems that are good enough: there's little incentive to experiment with anything else. This is fine when I'm thinking like a user, but it's not so hot when I'm looking for something new to write about. It's even worse for the people trying to get me to look at something new.

Most of you know that I'm partial to WORM drives in general, and the Maximum Storage WORM drive in particular. I've had a Maximum Storage WORM drive for a couple of years now, and it's more than good enough. I'll recommend the Maximum Storage WORM drive to anyone; and I've often said that if you're serious about the value of what you do on your computer, you'll get a UPS and a WORM drive, because anything less is gambling in ways you'll regret. The Maximum Storage WORM drive got a year's best award last year, and it has improved considerably since; it more than deserves its User's Choice.

A WORM drive is great for a single user. It's pretty good when a couple of users share it, for instance through an Applied Creative Technology Systematizer. As the number of users goes up, though, while it's important to have at least one WORM drive—it's still the absolutely best way to be sure you have kept and can retrieve every version of your work—using a single WORM drive to back up the work of many people becomes difficult, while setting up and enforcing a centralized plan for ensuring that all valuable work is saved and cataloged becomes nearly impossible.

Last year was supposed to be the Year of the LAN. I don't think it was, and I don't think this year will be, either, but it does seem clear that networked microcomputers are getting more important as time goes by, and they already are stealing large portions of a market that used to be the private preserve of the minicomputers, including VAXen. Now, one of the strengths of VAX systems was the ability of the MIS to set up and enforce backup plans whereby, like it or not, *everyone's* work was systematically copied off and archived. It was something you couldn't do with linked microcomputers.

That's no longer true. Comes now Palindrome, a network-archiving system for Novell and Novell-compatible LANs, which will do just about everything a VAX backup system can do. Palindrome is software and firmware to run an automated 2.2-gigabyte Exabyte tape cartridge backup system.

Palindrome first goes out and backs up everything; depending on the size of the network, this could take all night the first time you run it. Once it has done that, Palindrome then works iteratively, copying anything that changed since the last backup. It uses a sophisticated tape-changing scheme so there's no chance of losing everything; and, of course, you can periodically send tape cartridges off-site so that you have a chance to revive your company even if the place burns to the ground. It also records what it has done and catalogs the files it has archived.

Palindrome comes as a complete system with an Exabyte tape drive, or, if you already have an Exabyte tape drive but

continued

don't have software as good as Palindrome—and I don't know of any that is—you can get the firmware and software alone. Either way, if you are running a Novell network system or contemplating one, I strongly recommend Palindrome, the Chaos Manor Data Backup System of the Year User's Choice.

MNP and ARQ

Sometimes I think I have the noisiest telephone lines in the U.S.; at least when it rains in Los Angeles, I get world-class line noise. There is, however, a remedy. Not all communications networks have it. Tymnet doesn't, for instance, and BIX has it on only a few direct-dial lines. MCI Mail has it, though, as does GE's GEnie. I refer to a hardware error-correcting protocol system called MNP and ARQ. I confess I haven't the remotest idea of what those stand for, and what, if any, is the difference between them.

What I do know is that the new USRobotics modems can be set to use these protocols automatically. Once properly set, the modem sends a special signal to any modem it connects with. If it gets the proper return, the two go into communications in error-correcting mode—and you are not bothered by line noise no matter how bad the lines are. Moreover, when the lines are not noisy, the data transmission is much faster.

I don't have space for the technical details. But as a user, I find that MNP and ARQ pretty well solve the line-noise problems and speed up data transmission as well; and the USRobotics Courier HST Dual Standard modem wins hands down the Chaos Manor Modem of the Year User's Award. I love this thing.

Gadgets

I love gadgets; there's even a "gadgets" topic in the new technology conference that's part of my new exchange on BIX. There were a lot of really neat gadgets last year: the Atari Portfolio, a pocket-size DOS computer that I really like except that I can't get mine away from my son Alex; the Sharp Wizard; the Casio Boss; the Selectronics Word Finder; and a number of other dedicated special-purpose computers developed by Mike Weiner at Microlytics.

On reflection, though, one stands out: the Spectre GCR. Add this to an Atari ST, and you have, for all practical purposes, a Mac Plus. Add it to Atari's neat full-function portable ST, and you have a low-cost portable Mac Plus. The Chaos Manor Gadget of the Year User's Choice Award goes to Dave Small of Gadgets by Small for the Spectre GCR.

Mice

Like it or not, a good pointing device is becoming a necessity. I make no secret that I keep searching for new substitutes for the mouse. One product I mightily wanted to support was Logitech's TrackMan trackball system. Alas, for me it didn't quite make it. It was a good step in the right direction, but I find that the pointing device I prefer, and use at Chaos Manor, is not the TrackMan but Microsoft's "Dove-bar-shaped" Mouse. It fits the hand, looks nice, is easy to use, and gets this year's Chaos Manor User's Choice Award.

Orchids

Every year on BIX I ask for nominations for the Chaos Manor Orchids and Onions Parade: people, events, and things re-

continued

Circle 285 on Reader Service Card (DEALERS: 286)

"Xerox® this memo." "FedEx® this proposal." "LapLink® these files."

When something becomes a standard, using it becomes second nature. That's true about LapLink. It's so effective that it has become the most popular laptop-to-desktop and desktop-to-desktop file transfer program ever.

And now Release III improves on the original with added power— while preserving the simple design that has made LapLink the choice of more major corporations.

LapLink III offers both serial and parallel file transfer, and you can take advantage of parallel transfer speeds of 500,000 baud or higher. It comes with a "six headed" universal cable that provides you with everything you need to use both serial and parallel modes.

And LapLink III will even install itself automatically on a remote computer.

That's in addition to ease-of-use and productivity features like our popular split screen design, flexible transfer options, and disk and printer sharing.

For the same fast, error-free file transfers between PCs and Macintoshes, get LapLink Mac. And for more information about any Traveling Software product, call us at **(800) 662-2652.**

LapLink III. The standard in file transfer software.

Suggested Retail Price **$149.95**

LAPLINK III

TRAVELING SOFTWARE

Traveling Software, Inc.
18702 North Creek Parkway, Bothell, WA 98011
(206) 483-8088

Traveling Software Europe
Lords Court, St Leonards Road, Windsor
Berks, SL4 3DB, England
(44) 0753 831855

Circle 287 on Reader Service Card

lated to the computer community that made us happier and deserve orchids—and of course the stuff that deserves recognition for causing us problems.

A lot of good things happened last year. My orchid list includes:

Bill Gates, for his support of CD-ROMs. He has almost single-handedly built the market for this product; without his support, it certainly would not be where it is now and might not even exist.

American Express for their customer service: not just the AI programs that help their people make *fast* decisions on credit approval, but the whole card member privilege and support services they provide.

Tymnet, which, for all its problems, does listen and works on fixing things.

All of the above deserve orchids; but the Chaos Manor Orchid of the Year goes to Nolo Press, which is doing as much as anyone to help deliver the nation from its plague of lawyers.

Onions

The onion list is long, too; enough so that I'm going to omit the minor irritations and get right down to the real baddies:

Gould of Seattle, which makes disk mailers that are almost impossible to open; and once you have opened them, they have a horrible glue guaranteed to adhere on contact to any part of the disk that the container was supposed to "protect." I have lost three floppy disks to this outfit's mailers.

Those awful voice-synthesizer gizmos that allow magazine ads to talk to you.

The winner of the Chaos Manor Onion of the Year Award goes to electronic voice-mail systems that have clearly been installed by companies that no longer want customers and deserve to have their wishes fulfilled.

Computer of the Year

The Chaos Manor Computer of the Year is the machine I have found most useful; and that's always a tough choice, because I always have a whole bunch of computers that are more than good enough. I do tend to use the best and fastest machine I have, but I don't lightly switch from one to another.

I am still using Big Cheetah, the 386; but that's almost a fluke. The truth is, I would have changed to the Premier 9000, a 33-MHz 386, if I hadn't been promised a 486 machine in the very near future. The Premier 9000 is the fastest and cleanest-running machine at present in Chaos Manor, and by a good bit. It has been used as the primary test machine for odd software; it was used as a network server for a while; it has had OS/2 installed and taken off again; it was used to test Quarterdeck's *wonderful* new version of QEMM-386 and Manifest—if you have a 386, run, don't walk to get these—and in between times the Premier 9000 was put to use as the general-purpose workhorse for everything except writing books.

It's only fair, then, that the Premier 9000 is designated the 1989 Chaos Manor User's Choice DOS machine.

However: I give my awards for utility; and while I write all my books on DOS machines, I do an awful lot of my other work on Macs, which puts me in a genuine dilemma. I know I could do my books on the Mac. I'm not at all sure I could do my briefing charts and maps on a PC. Therefore, the Premier 9000 has to share the Computer of the Year Award with the Mac IIx, which generated the briefing charts we took to the White House; and I can honestly say that I'm glad I don't have to choose one or the other machine. They're both useful for the kind of work I do.

Winding Down

I've made a dent in the list of worthy software, but I see there's a lot more than I have space for. I don't know what I can do about that except rejoice that there's so much good stuff to work with.

The shareware of the month is Hieroglyphics for the Atari ST; this will let you write your name and history in genuine hieroglyphics that could have been understood by the pharaohs. It's available from the author, William Bentley (P.O. Box 2203, Santa Ana, CA 92707), or in the "tojerry/listings" section on BIX. The book of the month is *Nowhere to Go: The Tragic Odyssey of the Homeless Mentally Ill* by E. Fuller Torrey (Harper Torchbooks, 1989). It will tell you a lot you need to know about that problem.

Next month the mixture as before: a lot of good stuff came in yesterday. I sure love these little machines. ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

"Optical-ability"

Pinnacle Micro is the world's leader in removable, erasable, optical storage systems.

The expanding line of Pinnacle drives offers real solutions to mass storage problems and a whole new set of data handling capabilities.

Removable, Erasable, Opticalabilities.

Access-archivability.
Access your archives quickly and easily. Why wade through stacks of floppies or miles of tape to find a single file?

Platform-compatibility.
Interface kits are available for Macintosh, Sun, DEC, HP, IBM-XT, AT, PS/2 and compatibles, plus advanced applications such as Unix, A/UX, Xenix and Novell NetWare.

Infinite-storability.
Store huge files-CAD/CAM, multi-media, pre-press, 32-bit color. Each cartridge holds up to 650 megabytes. If one isn't enough, add another.

Data-securability.
Carry your world wherever you go. Put your operating system, applications, and data files on a single cartridge. Keep your data safe and secure or move it from place to place.

Interface kits available for MAC, SUN, DEC, HP, IBM A/T, X/T, PS/2 and compatibles from $495.

Upscale-ability.
Start with a single or dual-disk system for your network today. Move up to a 25 disk, 16 gigabyte system tomorrow. Your cartridges and your data will easily move up with you.

Crash-avoidability.
Eliminate crash anxiety, with laser technology there are no heads to crash. If your hard drive goes down your optical system will put you back on-line immediately.

Mass-movability.
Distribute massive amounts of data in limited quantities. CD-ROM's are great, but not if you need a reduced amount.

Problem-solvability.
Learn how to put these and other opticalabilities to work for you, call today for the name of your nearest authorized dealer.

(800) 553-7070

PINNACLE MICRO

15265 Alton Parkway • Irvine, CA 92718 • In CA (714) 727-3300 • FAX (714) 727-1913

THE ERASABLE OPTICAL STORAGE COMPANY™

Circle 222 on Reader Service Card

"The MKS Toolkit is an amazingly faithful replication of a System V UNIX™ environment."

– UNIX Review

"The entire MKS documentation package proved excellent in every respect"

Daniel McAuliffe, IEEE Computer, Jan. 1990

Powerful UNIX™ Tools for DOS and OS/2.

We can tell you that MKS Toolkit offers both experts and novices the purest form of UNIX utilities in a DOS or OS/2 environment. Fortunately, we don't have to. Software reviewers, universities, and major corporations all over the world are discovering MKS Software and how it can help their programmers and software developers make the most of their creative talents.

Reduce Keyboard Shock

With our proprietary code, the MKS Toolkit offers you more than 150 UNIX System V.5-compatible tools for DOS or OS/2. With MKS Toolkit, your computer or clone becomes a comfortable environment for shells, string matching, editing, file manipulation, and more. Productivity increases because all the familiar commands are at your fingertips.

"MKS software is absolutely the best in its class. Don't mix environments without it."

Grover Righter Director Hybrid Systems, Novell Netware Product Division

Site Licences

MKS Toolkit reflects its users' needs. Organizations such as AT&T, H-P, ITT, and NCR - all heavily committed to the UNIX system - use MKS Toolkit to create a standard operating environment. Universities, from Harvard to UCLA, use MKS Toolkit to enrich personal research computing environments and double the bandwidth of their PC teaching labs. The National Institute of Standards and Technology uses MKS Toolkit as a standard operating environment for experts and as a POSIX training tool for neophytes.

Interconnectivity

MKS Toolkit interacts well on standard PC and PS/2 networks. Combined with Novell Netware™, the most popular LAN for PCs, MKS Toolkit creates a UNIX time sharing system in DOS or OS/2 organizations. UNIX shops can now hook up all their PC's using PC-NFS™) and MKS Toolkit, enabling you to use a PC as a Unix workstation and off-load your mini or main machine.

POSIX Tools

MKS is an active participant on the POSIX 1003 standards committee. This involvement reflects MKS's commitment to tracking the shells and utilities standard to the fullest extent possible under DOS or OS/2. Apart from mult-tasking and constraints on file names under DOS or OS/2, MKS Toolkit follows the POSIX standard. MKS achieves this by building the underlying POSIX system on DOS or OS/2 before moving utilities.

POSIX Training

Government departments and organizations choose MKS Toolkit as a cost-effective means of familiarizing personnel with the POSIX environment – now a Federal government standard for computing.

Cost-effective Learning Tool

If your organization is committed to moving into the UNIX environment, then MKS Toolkit is the perfect learning path. DOS or OS/2 users retain the familiar world of the PC keyboard and programs and move effortlessly to a UNIX environment on their desktop. Exposure to new commands and functionality now becomes an integral part of the novice's working day.

"With this package, you can become familiar with the UNIX environment on your microcomputer, with DOS only a keystroke away."

Byte Magazine, May 1989

MKS Programming Platform

MKS Toolkit is the heart of the MKS Programming Platform. MKS Platform helps smooth out the details of programming and software development by adding time-saving utilities such as: MKS RCS (Revision Control System), MKS Make™ (automated program builder), MKS LEX & YACC™ (compiler learning and construction tools). Also available is MKS SQPS™ an enhanced version of the Documentator's Workbench™ with complete troff tysetting capabilities.

In all, you simply cannot find a more complete set of commands and utilities to get you from DOS or OS/2 to UNIX or POSIX. With MKS Toolkit or Platform, you get there fast, stress-free, and with no extra investment in hardware.

Full 30 day money back guarantee.

For more information, or to order, call: 1-800-265-2797 (continental U.S. only)
1-519-884-2251 (outside continental U.S.) 1-519-884-8861 (FAX)

35 King Street North, Waterloo, Ontario, Canada N2J 2W9

Put The Power Of UNIX In Your PC.

Circle 195 on Reader Service Card

THE UNIX /bin ■ David Fiedler

GETTING UUCP RUNNING, AND OTHER STORIES

The details of setting up Unix communications can be overwhelming without a little direction

There's a good reason for the wry title of this month's column. Trying to set up UUCP (Unix-to-Unix copy) has gotten many people running—as far away as they can get from even the *thought* of Unix!

Luckily, things are better these days. Many systems have automatic UUCP setup scripts or menus that make the process a lot easier. But without automatic setup, it's still an intricate mechanism of tables and daemons (background programs).

This month, I'll go over some of the inner workings of the UUCP subsystems, with particular reference to the mundane aspects of setting it up and getting it running. I will assume, for this column, that a setup script is *not* available; it doesn't often do what you want, anyway.

Hard Facts

The first hurdle to clear in your race for intersystem communications is hooking up your modem. While most modems will work (at a minimal level) with factory configurations on most computers, this is not what you want, except perhaps when you initially test the modem.

On single-tasking operating systems, you generally operate the modem manually by dialing out, using a telecommunications program. This gives you direct control over what the modem is doing. But a Unix system will place and receive its own calls whether you're there or not. So the full complement of modem-control signals must be used, especially Data Terminal Ready (DTR) and Data Set Ready. These correspond to pins 20 and 6, respectively, on a standard DB-25 connector. If this is not done, your modem may stay on-line for hours after a call has failed, running your phone bill way up.

Generally, the pins that should be connected (straight through from one end to the other) are pins 1 through 8, and pin 20. Some modem/computer combinations have to be cross-wired: 2 on one side to 3 on the other, 4 crossed with 5, and 6 with 20. This is known as a "null-modem" cable and can be used to connect two computers directly, back-to-back. But test your regular cable first.

If all this talk of pins confuses you, just make sure you use a modem-to-computer cable with at least nine internal wires. Test the connection as described below; if your modem operates satisfactorily, all is well.

Talking to the Modem

You need both read and write permission on the modem port to test the connection. On some systems, you may have two different names for the same physical port: one with the modem-control signals and one without. If so, test both, but use the modem-control device for "real" work whenever possible.

In the following examples, I've used the actual entries from my own SCO-based system; be sure to substitute the correct port names and data transfer rates for your machine.

On my system, I've found through trial and error that the only way to get my modem to operate correctly with all my communications programs is to allow dial-ins on the modem-control port (`/dev/tty1A`) and to perform dial-outs on the non-modem-control port (`/dev/tty1a`). The `uudemon.hour` shell script (the one that performs UUCP dial-outs) disables log-ins until UUCP is done and then reenables them. It may not be standard, but it works on my machine!

continued

ILLUSTRATION: MIRIAM SCHAER © 1990

Getting to Know cu

It's time to edit some files in the `/usr/lib/uucp` directory. In the current HoneyDanBer (HDB) version of UUCP, the file that describes what port to use for dial-outs is called Devices (previous UUCP versions called it L-devices). A typical entry in this file might be `Direct tty1a - 2400 direct`. This lets you talk directly to the modem port via the `cu` program. Except for the port number and data transfer rate, it should look the same on your machine. If you want to talk to the modem at different speeds, make similar entries at different speeds.

Test your Devices entry by typing `$ cu -l /dev/tty1a`. You should get a `Connected` message from `cu`, indicating only that you've reached the modem port. Now type AT (it may not echo), and if all goes well, you should receive an OK from the modem if it's been set up to respond with status messages (and it should have been).

You can now type ATDT5551234 (replace the digits with the telephone number of an operating, answering computer) to connect to another machine. Once you connect, you're acting as a remote terminal to that computer. When you're done, type ~. (a tilde followed by a period) to end the `cu` session. The modem should hang up, and its DTR light should go out, showing that your modem control (at least from the DTR side) is working.

For UUCP, as well as dialing by name from `cu`, you will have to make another entry in the Devices file to tell the system about dialing capabilities. Mine looks like this:

```
ACU tty1a - 300-19200 dialTBIT \\D
```

This signifies that I have an automatic calling unit (ACU) on port `/dev/tty1a`. The first dash takes up space for a field naming a separate dialer port (an antiquated method). The usable data transfer rate (or range, in this case) follows.

The next field, `dialTBIT`, references the name of the modem for dialing purposes. This can be a separate program but is usually an entry in the Dialers file, which describes the protocol involved in getting a phone number to the dialer. The `\\D` simply means, "Use the system phone number exactly as found in the Systems file." A `\\T` would mean to translate the number passed to the dialer, using information found in the Dialcodes file (I've never personally had any luck using Dialcodes files).

Now, you should be able to dial another computer by simply typing `$ cu 5551234`.

Finally, We're Getting Somewhere

From here to full UUCP capabilities is only a short step. The Systems file (`L.sys` in previous versions of UUCP, with a slightly different format) tells UUCP the names of the systems you can call, plus their phone numbers and log-in information. A typical entry looks like this:

```
lizard Any2300-0700 ACU 2400
    19165551234 \\
"" \\d\\r gin:--gin:-BREAK-gin:
    nuucp sword: foolyou
```

This lets my system call the "lizard" system on any day from 11 p.m. to 7 a.m. (when the phone rates are lowest); that it dials out (ACU) at 2400 bps; and that lizard's phone number is 1-916-555-1234.

continued

The rest of the line is a so-called "chat script" that alternates between strings to be expected from the other system and strings sent to the other system. The chat script begins executing once connection is made to the remote system. When you call a system using cu, the chat script is ignored.

The null string (i.e., the pair of quotes) means to initially expect nothing. It serves as a placeholder. The \\d\\r, meaning "Delay one second, then carriage return," is then sent out to the remote system. This expect/send pair is useful for goading systems that would otherwise wait too long to send their log-in prompt.

The next string, gin:--gin:-BREAK-gin:, anticipates the last characters of the log-in prompt from the remote machine. The double dashes request that another null string (actually a linefeed) be sent out if the first login: is not received within a few seconds. If this fails to produce the prompt, a BREAK goes out on the assumption that the other system is prompting at a different data transfer rate (sending a break at log-in time will generally cycle data transfer rates on Unix). If these three tries fail, then the chat script fails.

However, if the other system is running properly, one of these combinations should elicit the desired login: prompt, at which time the script knows to send out the UUCP log-in name of your computer (in this case, nuucp). Then, you expect to get a Password: prompt (again, you just look for the last few characters), at which time your system sends the message foolyou.

Then the fun begins, as UUCP connects to the other system and begins exchanging any mail and news that each system may have queued up for the other. To watch all this happen, run /usr/lib/uucp/uutry lizard or /usr/lib/uucp/uucico -r1 -Slizard -x9. You won't want to do this all the time, but it's essential for debugging chat scripts, and it's interesting when you're just getting started.

UUCP will block calls to systems if certain lock or status files exist, so you should remove them before testing. In HDB, these are /usr/spool/uucp/LCK* and /usr/spool/uucp/.Status/system (where system is the name of the system you're trying to call). Status files in earlier versions of UUCP are named /usr/spool/uucp/STST.system.

Finally, to make sure pending mail, news, and UUCP requests get processed, you must ensure that the uucico program executes once or twice an hour. The shell script /usr/lib/uucp/uudemon.hour should run from the cron task scheduler by the user uucp. Either /usr/lib/uucp/uusched or /usr/lib/uucp/uucico -r1 should be in the uudemon.hour script.

Next month, I will finish up the UUCP discussion with some more hints and tricks, and delve into some public domain programs that help make E-mail and UUCP a bit more interesting, if not easier. ■

David Fiedler is publisher of the Unix Video Quarterly *and the journal* Root, *as well as coauthor of the book* Unix System Administration. *He can be reached on BIX as "fiedler."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Ten Ports to Automatically
Share Printers, etc.
...Fast, Easy, and Inexpensive

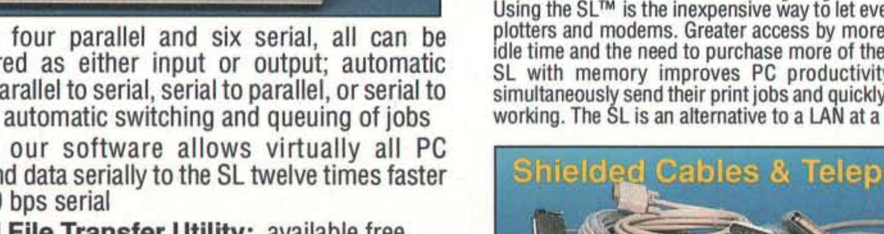
SL

$550 with 256KB
$700 with 1MB

PC Magazine [July 1989, Page 263]:
"The Buffalo SL peripheral sharing device is simple enough to use immediately yet sufficiently flexible to form the center of a fairly complex network. It's a good choice..."

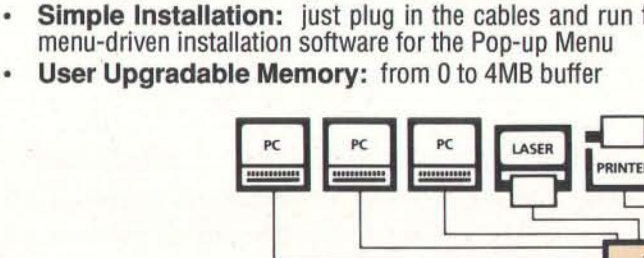
The SL Saves Money By Sharing Resources
Using the SL™ is the inexpensive way to let everyone share lasers, printers, plotters and modems. Greater access by more users reduces unproductive idle time and the need to purchase more of these expensive peripherals. An SL with memory improves PC productivity by allowing all users to simultaneously send their print jobs and quickly release their PCs to continue working. The SL is an alternative to a LAN at a fraction of the cost.

- **Ten Channels:** four parallel and six serial, all can be software configured as either input or output; automatic conversion from parallel to serial, serial to parallel, or serial to serial parameters; automatic switching and queuing of jobs
- **115,200 bps:** our software allows virtually all PC applications to send data serially to the SL twelve times faster than normal 9,600 bps serial
- **PC to PC Serial File Transfer Utility:** available free
- **Pop-up Menu via Hotkeys:** keyboard selection of printers, macros and many other control functions
- **Simple Installation:** just plug in the cables and run the menu-driven installation software for the Pop-up Menu
- **User Upgradable Memory:** from 0 to 4MB buffer



Smaller Switches

All Parallel Ports



AS-41 4 inputs to 1 output automatic switch without any buffer for only $200.

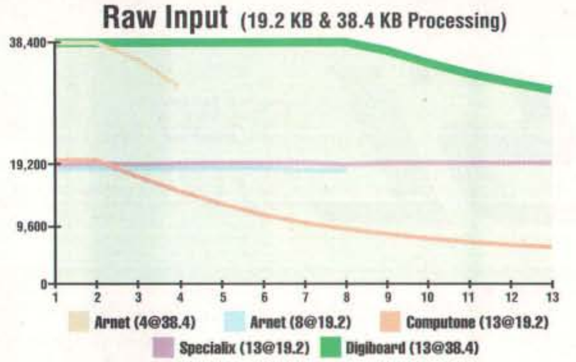
XE 2 automatic inputs to 2 electronic switch-selectable outputs from 256KB up to 2MB buffer, from $250 to $450.

45 Day Money Back Guarantee
CALL TOLL FREE TODAY

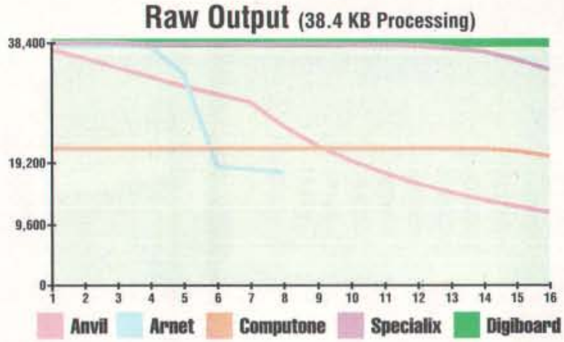
(800) 345-2356

Buffalo Products, Inc.
2805 19th St. SE
Salem, OR 97302
(503) 585-3414
FAX (503) 585-4505

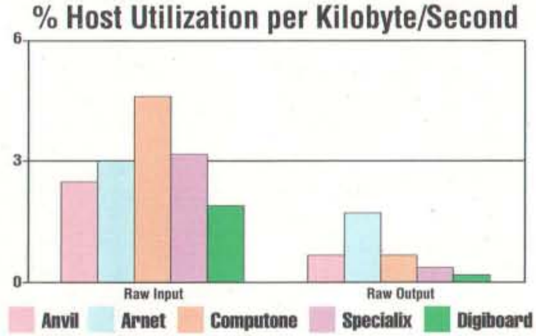
The new DigiCHANNEL series out-performs all other leading multi-user communications boards.



Raw Input: *Primarily data received via host-to-host communications. The higher the better.*



Raw Output: *Processed data from host applications to terminal users (spreadsheet, word processing, etc.) The higher the better.*



Processor Overhead: *Percentage of host CPU time utilized for I/O processing tasks. The lower the better.*

The new DigiCHANNEL series of multi-user communications boards sets the new performance standard for terminal response time, especially under heavy user-load conditions. The key to this performance is the synergy between our hardware and our new Front End Processing real-time Operating System (FEP O/S 5.4) software.

The proof is in the numbers, and a good example is the DigiCHANNEL PC/16i. In benchmark tests, it beats every other leading board in the two critical areas that determine board performance: *data throughput* and *processor overhead.*

Data throughput is calculated by measuring the total amount of data that a board can handle per port and per system. The higher the data throughput, the faster the response time for each user on the system.

Processor overhead is the amount of additional processing imposed on the CPU to handle the data input/output being controlled by the communications board. The less time the CPU needs to spend on I/O chores, the more time it can spend processing applications for terminal users.

Call for our FREE technical white paper with all the details on our benchmark testing. While you're at it, ask for our FREE booklet, *How to Do Multi-User Right.*

No matter how simple or complex your multi-user systems, you can trust DigiBoard to put you at the head of the pack. And keep you there.

DigiBoard

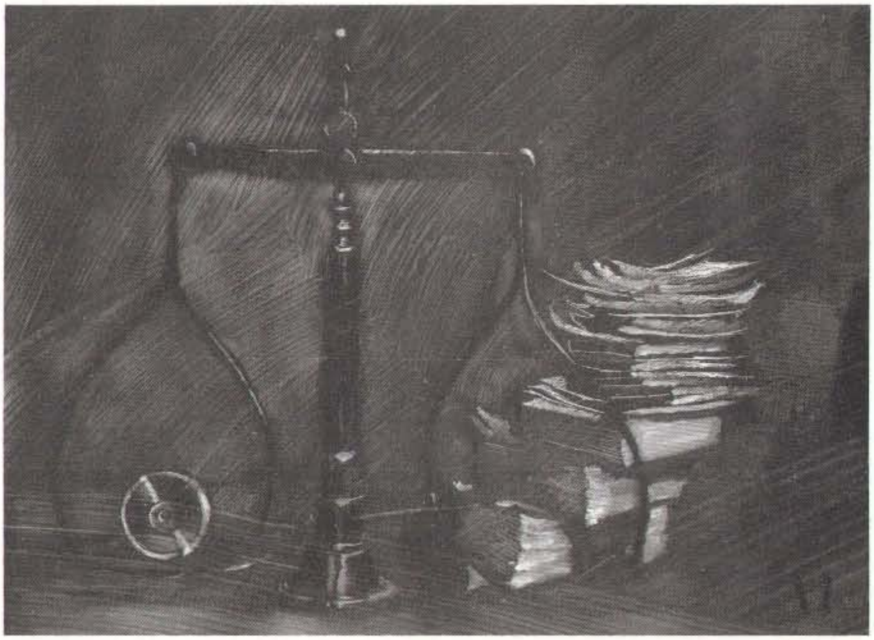
Plugging you into tomorrow.

6751 Oxford Street • St. Louis Park, MN 55426
1-800-344-4273 • In Minnesota (612) 922-8055

Circle 89 on Reader Service Card

CD-ROM TO THE RESCUE

If your business needs complete and accurate information in a hurry, databases on CD-ROM may fill the bill



Jim had a problem. A new client wanted to talk to his boss about a project that was being relocated to a remote site in the Pennsylvania mountains. Unfortunately, his boss was in a small hotel in Zambales in the Philippines, and it was now 3 a.m. there. Jim knew that overseas telephone calls are not always reliable and are not always answered in the wee hours. He also knew that his boss was leaving soon to see the new client, but at the old site.

Fortunately, Jim also knew that the international telex networks are quite reliable and immune to the interruptions that plague voice telephone traffic overseas. He knew that nearly every hotel in the world that caters to business travelers has a telex number. All he had to do was find the telex number for the hotel in the Philippines and send a message.

Unfortunately, this is easier said than done. While telex directories do exist, they are expensive; they normally cover only a few of the many networks in any area; and the thorough, accurate ones are massive, due to the hundreds of thousands of listings they must contain. Few businesses want to deal with the bulk, the expense, and the uncertain coverage of paper telex directories.

Jim's boss, of course, had no idea his client had a new site or where it was located. Thus, Jim knew he would have to find a source that would tell him about Pennsylvania and locate the new site's proper county and town.

Jim grabbed a copy of Time-Space Research's Supermap disk, inserted it into the CD-ROM drive on his PC clone, and loaded a list of the counties in Pennsylvania. This source provides information on localities and the demographic business and physical information about them. When he found the correct county, he looked at a map of the state, which had the county highlighted. It was clear from the map that the site had to be near Pittsburgh. With that in mind, Jim turned to the problem of the telex number.

Finding the telex number was even easier. Jim used the Jaeger+Waldmann worldwide CommDisc package, which provides every telex and teletex number and many fax numbers. Despite the vast quantity of information it contains—it takes two CD-ROMs to hold it all—the J+W CommDisc allows speedy search and retrieval. You can search by the name of the telex subscriber (or a portion of the name), its address, or its city or country. If you know only part of the information (e.g., the hotel name but not the city), you can search on what you do know. You will have to look at a few more entries, but it can be surprisingly few if you're careful what you ask for.

The CD-ROM telex directory includes the capability to display company logos, advertisements, and information beyond the telex number. Many companies also include a fax number, for example. The telex number listing includes the name of the telex network as well as the subscriber's answerback.

Within minutes, Jim was able to compose a message to his boss explaining the change in plans. With the information he had obtained from the CD-ROM, Jim gave his boss particulars about the new site, the name and location of the airport he needed to fly into, and the specifics of the meeting arrangements. Without the information on the disk, Jim's task would have been difficult, if not impossible.

Not every business needs a listing of

continued

ILLUSTRATION: MARK MOSCARILLO © 1990

ITEMS DISCUSSED

CDU-510 .... $895
Sony Corp. of America
Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000
Inquiry 1101.

Day-Timers Quick Trip Carryall $135
Day-Timers, Inc.
One Day-Timers Plaza
Allentown, PA 18195
(215) 395-5884
Inquiry 1102.

J+W CommDisc telex and fax directories $1850
Universal Media Division,
Shamgar, Inc.
212 Broadway
Bethpage, NY 11714
(516) 433-6767
Inquiry 1103.

or

Jaeger+Waldmann GmbH
P.O. Box 11 14 54
Birkenweg 8-10
1600 Darmstadt 11, West Germany
49 (6151) 3302-0
Inquiry 1104.

Supermap U.S. Census Data and Mapping Companion $4500
Chadwick-Healey, Inc.
1101 King St.
Alexandria, VA 22314
(703) 683-4890
Inquiry 1105.

or

Time-Space Research Pty Ltd.
668 Burwood Rd.
Hawthorn, East Victoria, 3123
Australia
61 3813-3211
Inquiry 1106.

all the telex numbers in the world. Likewise, not all of them need access to maps and demographic information like that provided in Supermap. The fact remains, though, that as businesses learn to meet the challenges of international growth, the need for information of all types has grown dramatically.

Once, all the information that most businesses needed was printed on paper. Most of it still is. Unfortunately, the amount of information has grown, while staffs have shrunk and the necessity for rapid response has increased. You no longer have the luxury of looking up information at your leisure, unless you want the competition to get there first.

One answer to this need for immediate access to great quantities of information is the CD-ROM. The demand for more and more information has resulted in significant growth in the quantity and variety of information available in this format. Where once reference material was limited to Microsoft Bookshelf, CD-ROMs are now available with contents ranging from the CIA's World Factbook to facts about additives in fast food. Many of these items are public domain information that has been packaged on CD, so the cost is surprisingly low.

Horizontal and Vertical Markets

The CD-ROM marketplace contains a great deal of vertical-market software and information. For reasons that I'll cover next month, this area of information is becoming very attractive to companies that need to provide large quantities of information for their customers.

Information for the horizontal market is aimed at a variety of businesses. Companies that publish horizontal-market packages on CD-ROM try to provide information that many types of businesses will use, and then they try to sell it to businesses in general. A CD-ROM reader similar to the Sony unit I looked at for this column now costs about $600. If you think that your business needs this type of resource more than a few times a year, you can probably justify the cost in terms of the staff time you will save and the accuracy you will achieve.

CD-ROMs intended for business use normally include search software optimized for the data on the CD-ROM. Frequently, this is in the form of a full-text database package that supports flexible queries with partial information. These packages are usually based on menus and are quite easy to use.

Are They for You?

Whether your business needs CD-ROMs depends on several factors. Some packages are quite expensive, although usually less so than their paper counterparts would be. They do require the installation of an additional drive and the addition of another internal circuit card. Most CD-ROM drives can play music and include a headphone jack and volume control. This is handy for long nights in the office, but it's more important as a way to include audio information as a part of the CD-ROM. This is especially useful in applications such as training. The Sony CDU-510 that I used for this column didn't have that capability, although Sony says it can be added.

One way to realize a greater return on your investment is to use CD-ROMs as a centralized resource, such as on a network. One company, CBIS (Norcross, GA), makes a CD-ROM server, although I haven't had a chance to use one yet.

The kind of business you have will determine the merits of moving to CD-ROMs for reference support. The economic feasibility of such a move depends on the equipment you already have—including existing computers that could be outfitted with a CD-ROM drive—and whether you're likely to use the information that is available. Once you have answered these questions, you can take the next step, which is to decide whether immediate access to this kind of information is important to your business.

Travel Update

In my September 1989 column, I wrote about some changes that were on the horizon for users who traveled with their computers. Since that time, some of those changes have happened, but some haven't. The most important is that the FAA didn't ban laptop computers from being carried on airplanes. What it did do, however, is begin enforcing the two-item limit for carry-on luggage. This means that you can no longer carry your computer along with your briefcase and an overnight bag. One of those has to be checked or left at home.

Fortunately, Day-Timers has introduced its new Quick Trip Carryall, a fabric briefcase that will hold a laptop computer, as well as a full complement of briefcase junk, a few spy novels, and the like. I was able to carry either Roberta Pournelle's Zenith SupersPort or the Zenith MinisPort that I took to Comdex. Each one fit with room to spare. Since notebook-size computers don't seem to come with rugged carrying cases and they don't leave much room for anything else in a standard briefcase, the Day-Timers Quick Trip Carryall, or something like it, is a must. ■

Wayne Rash Jr. is a contributing editor for BYTE and a member of the professional staff of American Management Systems, Inc. (Arlington, VA). He consults with the federal government on microcomputers and communications. You can contact him on BIX as "waynerash," or in the to.wayne conference.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.


Multiple choice.
JOHANNES JENSEN
President
MULTIMICRO, INC.
1. VIRTUALLY UNLIMITED SYSTEM CONFIGURATIONS: Our popular MultiMicro 386/25 and 386/33 systems provide economical, yet powerful computer solutions. Our MultiMicro Tower VGA 386/25 and Super Tower VGA 386/33 systems offer memory, hard drive and display options with unmatched pricing and performance.
2. MULTIMICRO CUSTOM COMPUTERS: Virtually any system configuration will be created to your exacting standards, with the assurance of MultiMicro quality.
3. COMPARE OUR COMPONENTS: Major names like Intel, Weitek, AMI, Western Digital, Maxtor, Imprimis, TEAC and Seiko. All providing top quality components with maximum reliability.
4. MULTIMICRO SEAL OF QUALITY. This seal guarantees that every piece of equipment has been hand inspected and electronically tested for 72 hours or more.
5. A POWERFUL WARRANTY. We will repair or replace your system for one year from date-of-purchase, with parts shipped overnight express. 24 hour turn around.
The multiple choice begins with a simple selection: Choose MultiMicro.
COMPLETE SYSTEM $1,495.
COMPLETE SYSTEM $7,99
COMPLETE SYSTEM $1,989.
MULTI MICRO Quality
▲ MMI-3364 SUPER TOWER
• AMI-80386 33MHz 64K CACHE STATIC RAM (25ns) • 4096K RAM USING 1 MB-70ns • DPT HARDDRIVE AND FLOPPY CTLR • 318MB ESDI HARDDRIVE (16ms ACCESS TIME) • VGA DISPLAY CARD w/512K RAM • TEAC 1.2MB 5.25" OR 3.5" HIGH DENSITY FLOPPY DRIVE • VGA COLOR MONITOR 1024 X 768 RESOLUTION • KEYTRONICS 101 KEY ENHANCED AT-KEYBOARD • 350 WATTS POWER SUPPLY • DUAL THERMOSTATICALLY CONTROLLED FANS
▲ MMI-386SX16
• MMI-80386SX 16MHz 1MB • WD1006 MFM HARDDRIVE AND FLOPPY CTLR • 30MB-38ms HARDDRIVE • MG 132 MONOGRAPHIC CARD WITH PARALLEL PORT • TEAC 5.25" OR 3.5" • SAMSUNG 12" MONOCHROME MONITOR • KEYTRONICS 101 KEY ENHANCED AT- KEYBOARD • 200 WATTS POWER SUPPLY.
MMI-386-25 MINI TOWER ➤
• MMI-80386 25MHz 1MB • WD1006 MFM HARDDRIVE AND FLOPPY CTLR • 30MB-32ms HARDDRIVE • MG 132 MONOGRAPHIC CARD WITH PARALLEL PORT • TEAC 5.25" OR 3.5" • SAMSUNG 12" MONOCHROME MONITOR • KEYTRONICS 101 KEY ENHANCED AT-KEYBOARD • 200 WATTS POWER SUPPLY
Circle 196 on Reader Service Card (DEALERS: 197)
582 FOLSOM STREET
SAN FRANCISCO, CA 94105
(415) 979-0140 FAX (415) 979-014
(800) 848-4256 Outside California
We Want to be Your Computer Company.
MULTIMICRO
INCORPORATED
ALL BRAND NAMES ARE REGISTERED TRADEMARKS OF THEIR RESPECTIVE COMPANIES.
FREE NATIONWIDE ON SITE SERVICE

TWO SIDES OF THE SAME COIN

Apple takes one step forward with education and one step back with software development

I work closely with Apple. Some of you have suggested that I work too closely and sometimes am too critical of Apple, because I feel for this company. I plead guilty to that charge. I know this company well, probably better than any other technology company I deal with. While I count many of its employees as my close friends, I do tend to take things that Apple does with at least some personal grain of salt. If I sometimes lose sight of Apple and its role in the bigger picture of commercial computing technology, I apologize. It's hard to watch a close friend make an error without spouting off about it.

But I also know when to praise Apple. This is one of those times. Most large hardware vendors have some kind of programs in place to encourage education, especially higher education. Most of these programs are simple grant or extended loan programs, where the vendor donates hardware to a school for use in its classes or research, sometimes with topical areas targeted for the grants. Thus, we've seen grants for developing courseware, teaching English, research in software engineering, and others.

While these programs are certainly worthwhile, they're really not much more than thinly disguised soft-sell marketing efforts. If a vendor can get faculty, staff, and especially students exposed to its machines on campus, the marketing theory says that they'll be enamored of that equipment and want to buy more (or buy it for their companies after graduation).

There's certainly nothing wrong with these tit-for-tat grant programs, but they don't go far toward helping schools in the business of teaching and research. Also, they don't build strong long-term buying constituencies for the computer companies. Apple has been a tit-for-tat company with its education grants for years, but recently it has branched out with new programs that don't have equipment donation as their primary interaction with the schools.

The Bright Side

One of these programs, Apple's Academic Marketing Competition, is two years old. The idea behind AAMC is to create a program within a group of targeted universities where students develop and execute their own marketing program. Not surprisingly, the marketing program has to be about Apple products generally, and the Macintosh specifically. And to keep that focus in mind, Apple donates two Mac SEs to each participating school and provides a fully equipped Mac lab to the winners (after all, this is a competition).

The way AAMC has worked so far is that Apple has identified some universities with a large or growing Mac presence and others where the Mac is just beginning to emerge as the machine of choice. Once these are identified, Apple uses its higher education marketing people already working with those schools to find a group of students on each campus willing to take part. Uniformly, this has meant working with a class of marketing students and their instructor (and other allied faculty). Significantly, not all the classes Apple has worked with in AAMC are business school marketing classes. Others have been journalism classes, graphics design classes, and those studying the sociological implications of technology marketing.

continued

The rules for AAMC are fairly clear and reasonably flexible. Each team works with its Apple higher education representative and has a $2000 budget (also supplied by Apple, and separate from the donated hardware). The team plans, puts together, and executes a specific marketing plan at its school. Each team uses the budget as it sees fit to buy advertising. Similarly, the teams can use the Mac SEs any way they choose. Most teams use the computers to design ads, plan schedules, write ad copy, produce radio commercials, and create storyboards for TV ads. Some choose to give away one or both of the SEs as part of the plan; others barter or sell one or more of the SEs to increase their budget.

Results of the competition are judged in a single-day presentation in front of a group of 10 judges selected from the computer industry. Each team spends 20 minutes presenting its campaign in any way it chooses, trying to convince the judges that its plan has been created and executed to perfection, and relying on Mac-generated multimedia to enhance the presentations. I recently spent a very enjoyable two days judging an AAMC in Chicago, so my memories of the whole process are clear.

The winner of the Chicago competition, the University of Missouri–Columbia, blew away the judges with the completeness of its campaign, how well it integrated the Mac into its campaign, and its preparation. On top of that, this team was a wonder at its presentation. In short, it was the only team to convince me and the other judges that we should hire it as our ad agency. And it did so by subtly influencing us with the technology of the Mac, its interface, and the ease with which the team pulled the whole thing off.

These kinds of competition change the way that personal computers are thought about and used in a broader range of careers. Apple deserves kudos for this, as well as our encouragement for future AAMC-style programs. If personal computing is ever going to live up to the promises made for it, such programs will have to become the standard, not the exception.

Personal computing is not about making a lot of money, nor about buying and using all the latest gear. Personal computing is about people using a malleable machine that can fit their work patterns theoretically better than any Swiss Army knife ever made. Apple has begun something significant with the Mac that goes way beyond user interfaces. Its revolutionary view of how personal computing is conceived is just now starting to take off and spread to others in the industry with a parallel vision. With programs such as AAMC, Apple has proven that it still maintains the conceptual lead over its competitors.

ITEMS DISCUSSED

Prograph 1.2.....................$195
TGS Systems
1127 Barrington St., Suite 19
Halifax, Nova Scotia
Canada B3H 2P8
(902) 429-5642
Inquiry 981.

A Darker Side

Having said all that, you still can't lose sight of the building blocks that make up the revolution. The personal computing revolution started by the Mac and fostered by Apple each year (much better this year than in previous years) is based on the Mac's user interface. Without that now-familiar Mac Desktop, we wouldn't be worrying about stuff like Motif, X Window System, Presentation Manager, Open Look, NewWave, and others.

The problem with the Mac has always been the paradox of software development. While the Mac user interface can be seen as the first ease-of-use win for personal computing users, it has been a royal pain for software developers. People who have been developing for the Mac since 1984 still complain about twiddling with the Mac's esoteric Toolbox ROM calls (which get more complex with each new CPU), its complex development system (MPW), and its arcane user-interface guidelines (which Apple regularly violates while nearly terrorizing developers into adhering to).

The problem of software development on the Mac is going to get worse. As System 7.0 rolls out this year, and Apple gets close to a CPU with 1 megabyte of ROM code, developers will be screaming for help. Apple should take a serious look at overhauling its developers' tools, probably by scrapping MPW (or rewriting it) and refining its MacApp object-oriented programming (OOP) tools.

Apple also needs to produce a lower-level developers' system that could be built on the ideas popularized in HyperCard and announced in AppleScript. It should include some of the nice prototyping features of Plus and Supercard, with structure and language editors on a par with Prograph and QUED. It wouldn't even have to be all Apple. The company could license parts of other systems for both the lower-level system (I call it the Mac User's Software Kit [MUSK]) and the professional system (I'll call it the Mac Professional Developer's Software Kit [MPDSK]).

Regardless of how Apple breaks these out and how it puts them together, the need is certainly there. Apple must make it easier for pros, semipros, and power users to roll their own applications and to distribute them to other Mac aficionados. Apple also needs to give MPDSK users the ability to cross-develop their software for other platforms. The "not invented here" syndrome won't do at all. Other graphical user interfaces (GUIs) are here to stay, no matter how many lawsuits get filed. Applications need to be developed with more than one computer in mind, and the translation between environments needs to be made as transparent as possible for developers.

Here is another one of those golden opportunities for Apple to take the lead in the personal computing revolution that it started. Just as it has recaptured the higher education market with innovative cooperative programs like AAMC, an Apple-developed cross-GUI programming system would set the pace for others to follow.

Tip of the Month

Speaking of development systems, I've been using a new one lately, called Prograph, from TGS Systems. So far, this graphically oriented OOP system lacks a compiler, but that should be completed by the time you read this. The Prograph system combines an OOP environment with a GUI programming environment that relies on visual programming metaphors (e.g., HyperCard). To this interesting mix, TGS Systems adds familiar data-flow diagrams.

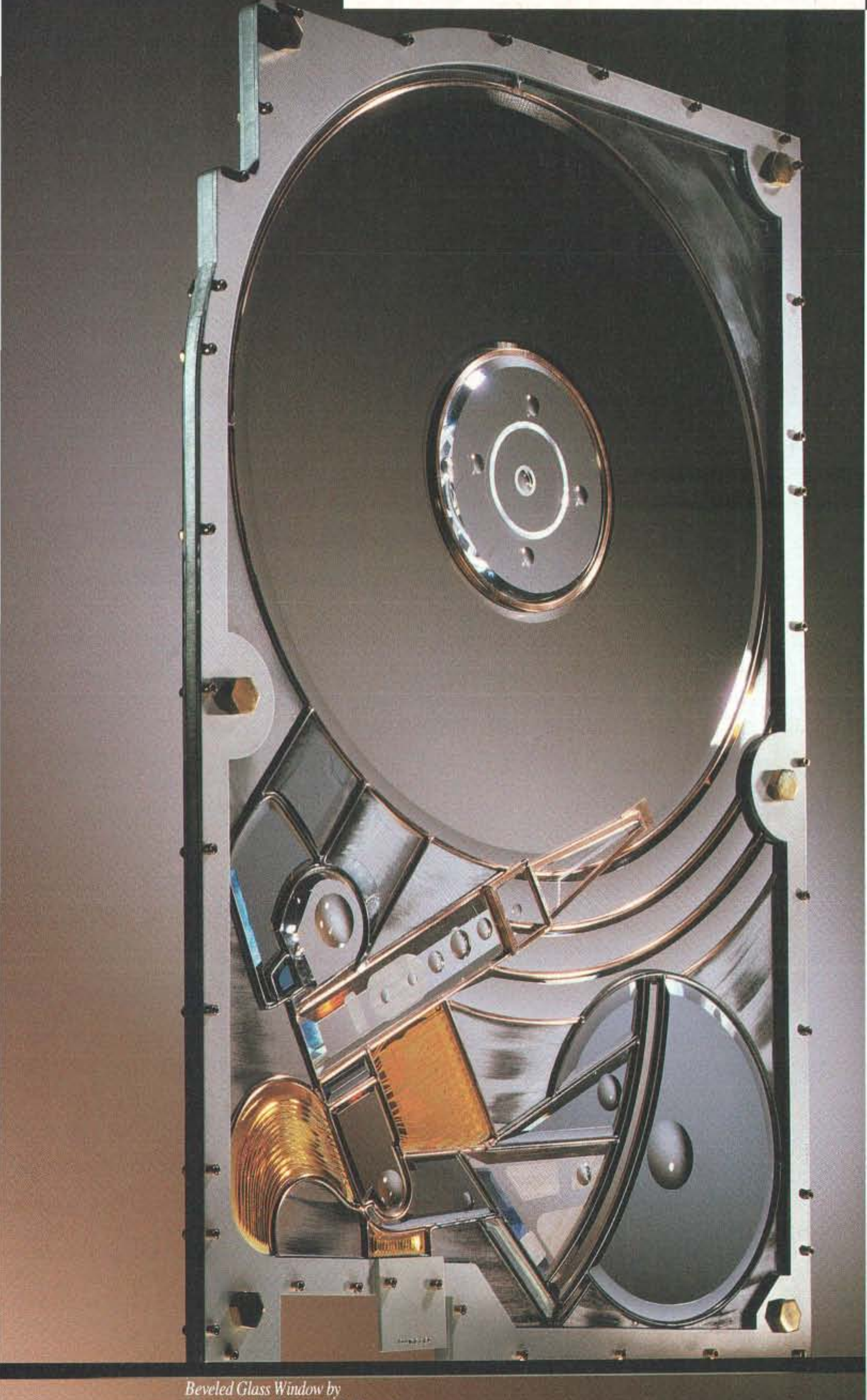
While Prograph 1.2 won't replace MPW or even Symantec's Think compilers, it's an important new kind of development system. If you've toyed with the idea of Mac software development before, but you were put off by the weaknesses of HyperCard and the complexities of MPW, look at Prograph. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. He is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Seagate's ST1096 Family

THE FINE ART OF DISC DRIVES



Beveled Glass Window by
Thomas Tisch & Andreas Lehmann
Oakland, California

Even to the experienced observer, a disc drive is a technological marvel. With discs spinning at 60 revolutions per second, the mechanics involved are astounding. It takes a company with a unique level of skill and experience to produce drives in volume that perform reliably year after year. A company like Seagate.

Our 3.5″ ST1096 family is a great example of Seagate craftsmanship. Featuring a choice of 42, 60 or 83 formatted megabytes, these high performance (24 msec average access time) drives are ready for demanding PC and Apple® applications. The family offers ST412/MFM and SCSI interfaces for application flexibility. And they all feature a 50,000 hour mean-time-between-failure rate.

Like the artist who spends years perfecting his craft, Seagate has spent the past decade mastering the fine art of disc drives. For more information on our multi-faceted product line, contact your authorized Seagate distributor, or call Seagate directly at 800-468-DISC, or 408-438-6550.

Seagate

Power Packed & Built To Last.

PC/XT

STANDARD 150 — $69

Economical This UL approved, fully tested unit is one of the best generic 150s available. Ideal for basic systems.

SILENCER 150 — $129

Ultra-Quiet Stop that irritating whine with the Silencer 150. Its large, low speed, West German fan keeps your system 5° to 15° cooler and 84% quieter. Virtually inaudible! Great in the executive suite or home office.

TURBO-COOL 150 — $149

High Performance Upgrade your PC/XT with our popular, UL approved Turbo-Cool 150. Its patented twin fan, sloped-cover design keeps your system 25° to 40° cooler and 50% quieter. Prevents intermittent data errors and other heat-related problems. Meets the demands of a fully loaded system.

TURBO-COOL 200 — $189

Maximum Performance Put AT power and 200% more cooling under the hood of your PC/XT with our UL approved Turbo-Cool 200. Its twin fans keep your system 30° to 45° cooler for maximum expandibility. Perfect for hot rod PCs and Mini ATs!

Silencer, Turbo-Cool, and Turbo 375 are trademarks of PC Power & Cooling, Inc. Compaq and Deskpro are registered trademarks of Compaq Computer Corporation.

AT/386/486

STANDARD 220 — $99

Economical This UL approved, fully tested unit is one of the best generic 220s available. Ideal for basic systems.

SILENCER 220 — $149

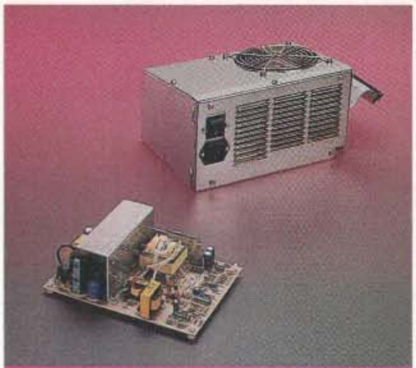
Ultra-Quiet Unrattle your nerves with the Silencer 220. Its high-efficiency, adjustable-speed fan offers 69% less noise with standard cooling. Quieter than most hard drives. Great in the executive suite or home office.

TURBO-COOL 250 — $189

High Performance Protect your investment! Upgrade your AT/386 with our powerful, UL approved Turbo-Cool 250. Its high-capacity, adjustable-speed fan keeps expansion cards, hard drives, and other valuable components 20° to 35° cooler for up to three times longer life. Perfect for a fully loaded system.

TURBO 375/450 — $299-$369

Maximum Performance The choice of PC professionals, our Turbo 375 and Turbo 450 feature built-in line conditioning, autoselect input, independent regulation, external DC voltage adjustment, remote switch option, enhanced cooling, UL/CSA/TUV approval, 50,000 Hr MTBF, and 2-year warranty! Ideal for workstations and network file servers.



COMPAQ

CP160 — $169

Original Portable Upgrade Give your Portable greater reliability and 100% more power with our direct replacement CP160. Allows 286, 386, and hard disk upgrades.

CD270 — $249

Deskpro Upgrade The power user's power supply! Our direct replacement CD270 gives your 8086/286/386 Deskpro up to 70% more power and the reliability it deserves. Prevents nuisance rebooting. Advanced design includes autoselect 110V/220V. 2-year warranty.

Our power supplies feature:

- Full-rated power
- UL/FCC compliance
- 110V/220V input
- 4 drive plugs (min)
- Heavy-duty components
- Low output ripple
- OVP, OCP, SC protection
- Installation instructions
- Rigorous testing
- 1-year immediate replacement warranty (2 years where noted)

"You could buy cheaper no-name power supplies almost anywhere, but don't. PC Power and Cooling's units are better made and more reliable than anything in the field."

PC/Computing
January, 1989

Most orders shipped same day. We accept Visa, MC, COD or PO on approved credit.

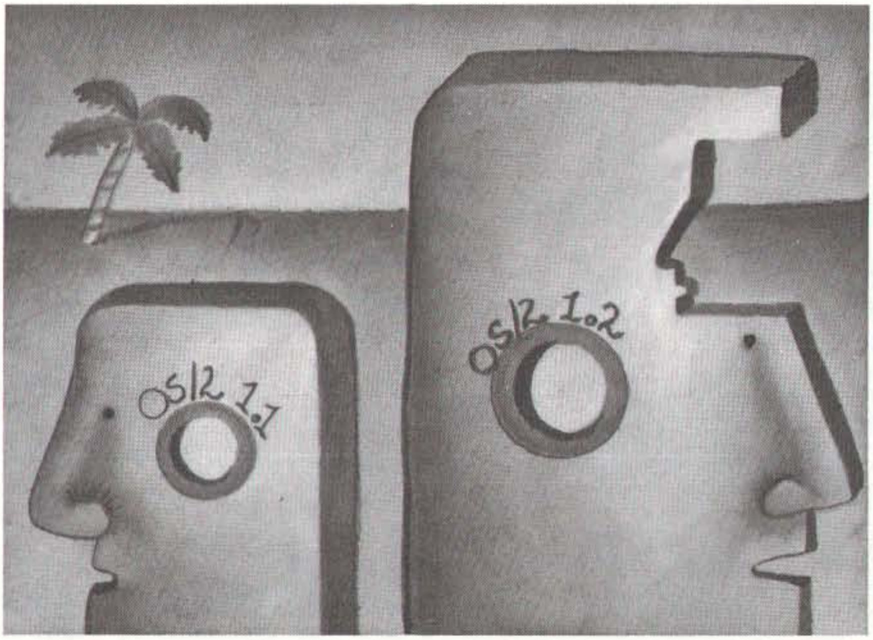
PC POWER & COOLING, INC.

31510 Mountain Way, Bonsall, CA 92003 • (619) 723-9513 • FAX (619) 723-0075

Circle 216 on Reader Service Card

LIVING WITH OS/2 1.2

Incremental improvements are a sign that OS/2 is maturing



I told you about using the High Performance File System (HPFS) last month. Now I'll look at OS/2 1.2 in general. I've been living with this new version for a while, and for those of you who are still thinking of taking the plunge, here are some of the things you'll find.

Compatibility

It appears that just about anything that ran version 1.1 will run version 1.2. As before, one of my OS/2 workstations has a DTK motherboard with the Phoenix BIOS 3.06 (you may recall that the DTK BIOS doesn't seem to work with OS/2). My Micronics 386 motherboard, as before, will not boot version 1.2. That's probably because this early Micronics motherboard required a daughterboard to use an 80387, and something about the daughterboard upsets OS/2, or so I am told.

I don't have a later motherboard to test this claim on because Trillian Computer, the company I bought the system from, has washed its hands of this particular computer—you see, the company doesn't sell Micronics motherboards anymore. Micronics has no suggestions, either, alas, so for now I've got to advise caution when buying Micronics motherboards for use with OS/2.

Of course, 1.2 runs on the IBM machines that I've tested it on, although running it on either the PS/2 Model 30 286 or the 50 Z is a joke: version 1.2 takes about 10 megabytes of disk space, about the same as 1.1, and both computers ship with 20-MB drives. I suppose that means that the official low-end IBM OS/2 machine will be the Model 50 Z, but most folks I know who are doing real work on OS/2 end up with the 386SX-based PS/2 Model 55 SX or the 386-based PS/2 Model 70.

If you're a Big Blue–only person, I'd suggest (reluctantly, as it's expensive) that you look at the PS/2 Model 80. It is built around a 386, can be gotten with the large hard disk drives that OS/2 really needs, and has numerous slots. You'll want the slots for the 8-plus MB of RAM that is needed for the Extended Edition or some other communications/database product.

Performance

I hate to say it, because I love the features that I get from OS/2 (e.g., large memory and multitasking), but it's *still* slow. For example, I do a lot of work with three object-oriented graphics packages: Generic CADD, a regular DOS application that creates its own graphical environment; Micrografx Designer, one of the best (if not *the* best) Windows-based object-oriented drawing programs; and Designer/PM, a beta version of Micrografx Designer for use with the Presentation Manager (PM).

The difference in speed of screen handling is remarkable and instructive. Because it does its own screen management, Generic CADD runs respectably on an 8-MHz 8088 machine. Designer, requiring Windows, needs at least a 10-MHz 286 to look decent. This isn't the fault of Micrografx: I've run many Windows programs, and they're *all* slower than their non-Windows counterparts. For another example, compare PC Paintbrush with PC Paintbrush for Windows. Both were written by ZSoft, but the non-Windows version is much faster.

The benefits of Windows are counterbalanced by its overhead. That's why

continued

Windows was renamed Windows/286; you can certainly run Windows/286 on an 8088 machine, but you really don't want to. However, Windows looks positively snappy compared to PM: Everything takes forever on a 286. PM's overhead must be tremendous. And 1.2 has not solved the problem. I suppose it's another argument for not buying below 386 machines if you're running OS/2.

I just wonder how long it will be before OS/2 runs without delays. Next-generation video hardware should solve the problem.

Don't get me wrong, I'm not beating up on OS/2. I'm just wondering how long it will be before it runs without delays. Next-generation video hardware will solve the problem, if PC vendors can get together on a standard.

The problem stems from the basic approach to putting graphics on the screen. Suppose a program wants to put a circle on the screen. With the popular graphics boards (i.e., CGA, Hercules, EGA, and VGA), the program describes the circle as a series of commands to place dots, or pixels, on the screen. Basically, it does a pile of calculations that are familiar to students of trigonometry: sines, cosines, and the like. (That's why a numeric coprocessor improves the performance of most graphics programs.)

This pixel-by-pixel approach is, as you'd imagine, quite compute-intensive. It's also video-board-type-specific: You have to know how many pixels exist on a VGA to write a VGA driver, how many on an EGA for an EGA driver, and so on.

The newest video boards take high-level graphics commands independent of board resolution. The width and height of the screen are defined as 1.0, and a point can be placed anywhere from (0.0, 0.0) to (1.0, 1.0). For example, the center of the screen would be (0.5, 0.5).

Nor must the program direct the board to place pixels in order to define a circle. Instead, the program just tells the video board to place a circle on the screen, centered on a given point and extending for a given radius. It's a more efficient system because the video board has a microprocessor on-board that's been optimized for this kind of work.

Texas Instruments and Intel make chips that are intended for just this kind of thing; the problem is that no big PC vendor has popularized the idea enough to make it cheap. The TI34010 graphics chip isn't exactly new and untried at this point. Why not embrace it? Perhaps someday soon. If the slowness of the PM's screen handling isn't enough to spur the development of such products, I don't know what is.

Needed Fixes: Fonts and the Spooler

Two really annoying features of 1.1 were the buggy spooler and the hidden fonts. The spooler, as I've mentioned in previous columns, was pretty useless under 1.1. Version 1.2's spooler seems better, and now there are printer drivers for PostScript and Epson printers, Hewlett-Packard plotters, and a number of IBM printers.

The Times Roman and Helvetica fonts are now also preloaded into the PM, so there is no more wandering through the Control Panel. With 1.1, you got (in addition to the usual monospace Courier font and the proportional Helvetica-like System font) those ever-popular mainstays of desktop publishing, Times Roman and Helvetica.

Unfortunately, the fonts were *copied* to the hard disk by the automatic installation procedure, but not *installed*—the two actions are separate under both Windows and PM, and it takes some digging in the manuals to figure out what must be done and how to do it. You probably needn't worry about it here, however, as 1.2 preloads the fonts—a nice touch, and a needed one.

Improvements

Here are some more welcome changes that I found in version 1.2.

Command history. Many of you no doubt use a program like DOSEDIT or CED under DOS to remember previous commands. Such a program lets you recall the last 20 or so commands, edit any command, and reissue it just as if you'd typed the whole line.

For those who don't use something like that now, let me tell you, it's indispensable, because it saves retyping lines entered in error and simplifies repetitive tasks. A public domain "command

continued

history" program for OS/2 named Alias has been around for a while, but it's nice not having to hunt around for Alias every time I set up a system. Thanks, Microsoft and IBM. How about putting this feature in DOS?

On-line documentation. Rather than having to hunt around for the manual to look up some obscure syntax, there is now an on-line command reference that is installed (optionally) by the Install program. Take my advice and install it. You see, you don't get a manual with IBM OS/2 1.2 that completely describes the commands. You must install the command reference on-line or buy the separate command reference book from IBM (lesson number 457,199 in "how to annoy customers").

The command reference is as complete as the old OS/2 manuals. Since there are new options for several commands, take a look at the on-line reference before going too far with OS/2. Oh, and a hint on using the reference: You'll see a command syntax tree showing each option, but no description of what each option does. What you must do to get more information is to click, hypertext-like, on the option itself—you'll get the whole story then.

No more unnecessary disk checks. Version 1.1's file manager had an incredibly annoying habit. When it started up, it checked each floppy disk drive to see if there was a disk in the drive. As there generally is *not* a disk in the drive, the file manager waited a minute or two for each drive to time-out, and believe me, that minute got longer every time you loaded the file manager. No more.

Dual boot. Dual boot has been needed for some time, and it's a welcome addition. One problem with dual boot was setting up the directories for both DOS and OS/2: OS/2 left the root directory a real mess, with some basic system device drivers required to be in the root directory. But that's all fixed.

The change from 1.1 to 1.2 was more evolutionary than revolutionary (save, of course, for the HPFS), but perhaps that's because OS/2 is starting to mature. We'll see just *how* mature when the 386 version appears. ■

Mark J. Minasi is a managing partner at Moulton, Minasi & Company, a Columbia, Maryland, firm specializing in technical seminars. He can be reached on BIX as "mjminasi."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

More Powerful Than Ever . . . Up To 5 KVA

STANDBY UPS MODELS
- 250 To 1600 Watt Output
- Synchronized Sinewave with 1 msec Switching Time
- Full One Year Warranty

ON-LINE UPS MODELS
- 1000 To 5000 VA Sinewave Output
- True On-Line — Total Isolation
- Static Bypass Switch Standard

SHUTDOWN SOFTWARE
- Auto Shutdown of Local Area Networks for Unattended Operation
- Compatible with SCO XENIX 2.2.3 and above
- Novell ELS 2.12 and above
  Advanced Netware 2.11 & above
  SFT Netware 2.11 and above

MINUTEMAN®
UNINTERRUPTIBLE POWER SUPPLIES

STANDBY UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
250 WATT	$ 379.00	$ 429.00
300 WATT	$ 549.00	N/A
500 WATT	$ 699.00	$ 799.00
600 WATT	$ 899.00	$1049.00
900 WATT	$1249.00	N/A
1200 WATT	$1499.00	$1749.00
1600 WATT	$1999.00	$2299.00

TRUE ON-LINE UPS MODELS

Power Output	120 Volt Models	208-240 Volt Models
1000 WATT	$2249.00	Available
3000 WATT	$5495.00	Available
5000 WATT	$8950.00	Available

UL LISTED

FOR L.A.N.
NOVELL LABS TESTED AND APPROVED
NetWare Compatible

PARA SYSTEMS, INC.

1455 LeMay Drive
Carrollton, TX 75007

Telephone:
(214) 446-7363

1-800-238-7272

FAX: (214) 446-9011 TELEX: 140275 OMEGA

April 1st is funny.

Adobe Systems ... NCP
▣*Streamline Windows 1.0*–Converts your bitmapped images to PostScript format. Imports TIFF, PNT, and PCX formats. Exports to EPS, Illustrator, Corel Draw and Micrografx Designer.......... **$229.**

□ **3½" format available from us. Specify when ordering.**
▣ **package includes both 5¼" and 3½" disks.**
⊞ **3½" format available from manufacturer by request. Call us for details.**
CP—copy-protected; **NCP**—not copy-protected.

The four-digit number next to each product is the product's ITEM NUMBER. Please refer to this number when ordering. Thank you.

SOFTWARE

We only carry the latest versions of products. Version numbers in our ads are current at press time.

Corel Systems ... NCP
□*Corel Draw 1.1*–You get over 100 typefaces and over 300 pieces of clipart free! Change colors, rotate, stretch, copy, combine fill with patterns and fountains–the possibilities are endless and exciting........... **$329.**

Adobe Systems ... NCP
6591 ▣Illustrator Windows 1.0........ $279.
6590 ▣Streamline Windows 1.0 .... 229.
Aldus ... NCP
1332 □PageMaker 3.0 .... 499.
Alpha Software ... NCP
5104 ▣Alpha Four 1.1 .... 319.
4103 ▣Alpha Works 2.0 .... 89.
Application Techniques ... NCP
1214 ▣Pizazz Plus 1.3............... 69.
Ashton-Tate ... NCP
4450 □dBASE IV 1.0 .... 499.
Autodesk ... NCP
4519 □Autosketch 2.0............... 95.
6119 □Autosketch Animator 1.0 .... 189.
Avery ... NCP
6006 ▣Label Pro 1.0................ 49.
Bitstream ... NCP
▣Fundamentals:
Reports and Proposals, Presentations or Spreadsheets .... *each* 159.
▣Headlines *(1 to 6)*........ *each* 99.
▣Individual Fonts .... *each* 99.

Alpha Software ... NCP
▣*Alpha Four 1.1*–The award-winning, fully relational database management & application development system for business people, not programmers. Offers sophisticated reports and customized applications .... **$319.**

Bloc Publishing ... NCP
1447 □FormTool 2.01 .... 55.
6245 ▣PopDropPLUS 1.0............ 59.
Borland International ... NCP
4330 ⊞Turbo C Professional Pack 1.0 .... 175.
4332 ⊞Turbo Pascal Professional Pack 1.0. 175.
6242 ▣Quattro Pro 1.0 .... 289.
1514 ▣Paradox 3.0................ 469.
Brightbill-Roberts ... NCP
5408 □Hyperpad 1.0 .... 89.
5843 □Show Partner F/X 3.5.......... 229.
Broderbund ... CP
1434 □New Print Shop *(NCP)* .... 39.
1433 ▣Memory Mate 3.01 *(NCP)* .... 45.
ButtonWare ... NCP
6419 ▣PC-File 5.0.................. 75.
Caere ... NCP
6004 ▣Omnipage 386 2.1 .... 599.
Central Point ... NCP
5039 ▣PC Tools Deluxe 5.5........... 77.
5038 □Copy II PC 5.0............... 27.

Chipsoft ... NCP
1663 ⊞TurboTax for 1989 Taxes 7.0..... $45.
⊞Individual States...........each 34.
Chronos Software ... NCP
4387 ▣Who•What•When 1.09 .... 119.
Concentric Data Systems ... NCP
6575 ▣R & R Relational Report Writer 3B 109.
Corel Systems ... NCP
5506 □Corel Draw 1.1.............. 329.
Crosstalk Communications ... NCP
2908 □Crosstalk XVI 3.7 .... 109.
5611 □Crosstalk for Windows 1.0 ...... 129.
DacEasy ... NCP
1748 ▣DacEasy Accounting 4.0 .... 89.
Data Storm ... NCP
4798 ▣PROCOMM PLUS 1.1 .... 52.
Delrina Technology ... NCP
4325 ▣PerFORM 2.0............... 169.
Delta Technology ... NCP
5829 ▣Direct Access 4.1............. 52.
Digital Composition Systems ... NCP
5876 ▣db Publisher Report Maker 2.0 . 185.
Dow Jones ... NCP
5494 ⊞News/Retrieval Membership Pkg. 24.
5th Generation ... NCP
2762 □Mace Utilities 1990............ 89.
3950 ▣Fastback Plus 2.09 .... 109.
FormWorx ... NCP
5810 □FormWorx with Fill & File 2.5 ..... 85.
Fox Software ... NCP
6188 ⊞FoxPro 1.0.................. 489.
2233 ⊞Foxbase Plus 2.1 .... 199.
Funk Software ... NCP
2228 □Sideways 3.21 .... 42.
4479 □Allways 1.0 .... 85.
Generic Software ... NCP
2265 ⊞Generic CADD Level 3 1.13.... 169.
Great American Software ... NCP
4880 □One Write Plus Accounting Sys. 2.0 .179.
5825 □Money Matters 1.0............ 55.
Harvard Associates ... NCP
2324 ⊞PC Logo 3.0 .... 59.
Hayes ... NCP
2293 ▣Smartcom II 3.0............... 89.

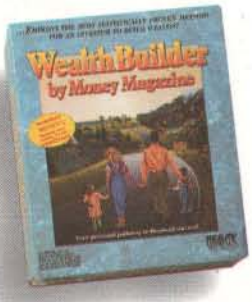
Microcom ... NCP
□*CarbonCopy Plus 5.2*–Links two PCs, their keyboards, screens, and disks. You can have complete control of a remote PC's application software from your own PC.... **$115.**

PC CONNECTION®

We've got what it takes

Timeslips ... NCP
□*Timeslips III 3.4*–Track every minute's efforts, then print the invoice and log the receivable all from the convenience of Timeslips III. Menu-driven and memory resident, this is a must for your service business..... **$169.**

Timeslips ... NCP
2987 □Timeslips III 3.4 .... 169.
Timeworks ... NCP
6253 ▣Publish-It! 1.1 .... 115.
TOPS ... NCP
3726 □TOPS Network Bundle 3.0 ...... 159.
3720 *Flashcard 2.1 (AppleTalk network card; 1 year warranty)* .... 179.
Traveling Software ... NCP
4190 Battery Watch 2.0 *(3½" only)* ...... 35.
5179 ▣LapLink III 3.0 .... 85.
True BASIC ... NCP
3561 ▣True BASIC 2.1 .... 52.
Vericomp ... NCP
3765 ▣SoftBytes 2.0 .... 35.
WordPerfect Corp. ... NCP
3799 ▣WordPerfect Library 2.0......... 75.
3804 □WordPerfect 5.1.............. 265.
WordStar USA ... NCP
2825 □WordStar Prof. Release 5.5 ..... 229.
5000 □*Upgrade to Release 5.5*......... 89.

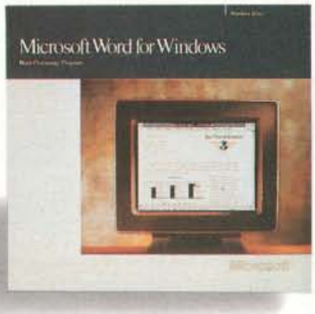


Reality Technologies ... NCP
▣*WealthBuilder by Money Magazine 1.1*–Save & invest wisely. Set financial goals & achieve them. Plan for retirement, a child's education, a home. Optimize your portfolio & track all of your investments .... **$145.**

Xerox ... NCP
3812 □Ventura Publisher 2.0......... $529.
6505 □Formbase 1.0 .... 319.
XTREE ... NCP
6161 ▣XTreePro Gold 1.3 .... 75.
XYQUEST ... NCP
4393 □XyWrite III Plus 3.55........... 229.

RECREATIONAL/EDUCATIONAL

Broderbund ... CP
1417 □Where/Europe Carmen Sandiego? 32.
5701 □Where/Time Carmen Sandiego? ... 32.
Electronic Arts ... NCP
6436 ▣Hunt for Red October .... 35.
4659 ▣Chessmaster 2100 *(CP)*......... 35.
5804 ▣Deluxe Paint II *(Enhanced)*....... 89.
Microprose ... CP
4454 □F-19 Stealth Fighter .... 39.
5823 □Red Storm Rising............... 39.
Microsoft ... NCP
2858 □Flight Simulator 4.0 .... 39.



Microsoft ... NCP
▣*Word for Windows*–Combines the power of Word for the PC with ease of use and WYSIWYG accuracy of Microsoft Windows. Integrate graphics and data from Windows applications into your documents.... **$329.**

Parlor Software ... CP
3159 □Bridge Parlor 2.3.............. 49.
Sierra On-Line ... CP
6023 ▣Leisure Suit Larry III............ 39.
5695 ▣Manhunter: San Francisco....... 33.
4456 ▣Police Quest II .... 39.
5106 ▣Space Quest III .... 39.
6022 ▣Colonel's Bequest .... 39.
Spectrum Holobyte ... NCP
5993 ▣Welltris *(Tetris sequel)*.......... 22.
Spinnaker ... CP
5580 □Sargon IV .... 32.
Stone & Assoc. ... NCP
3435 ▣My Letters,Numbers,Words *(2 to 6)*22.
3438 ▣1st Math *(ages 5 to 8)*........... 22.
3439 □2nd Math *(ages 7 to 16)*......... 27.
5231 ▣Phonics Plus .... 22.
Sublogic ... NCP
6190 □Air Transport Pilot.............. 33.
True BASIC, Inc. ... NCP
▣Kemeny/Kurtz Math Series: 10 titles .... *each* 45.

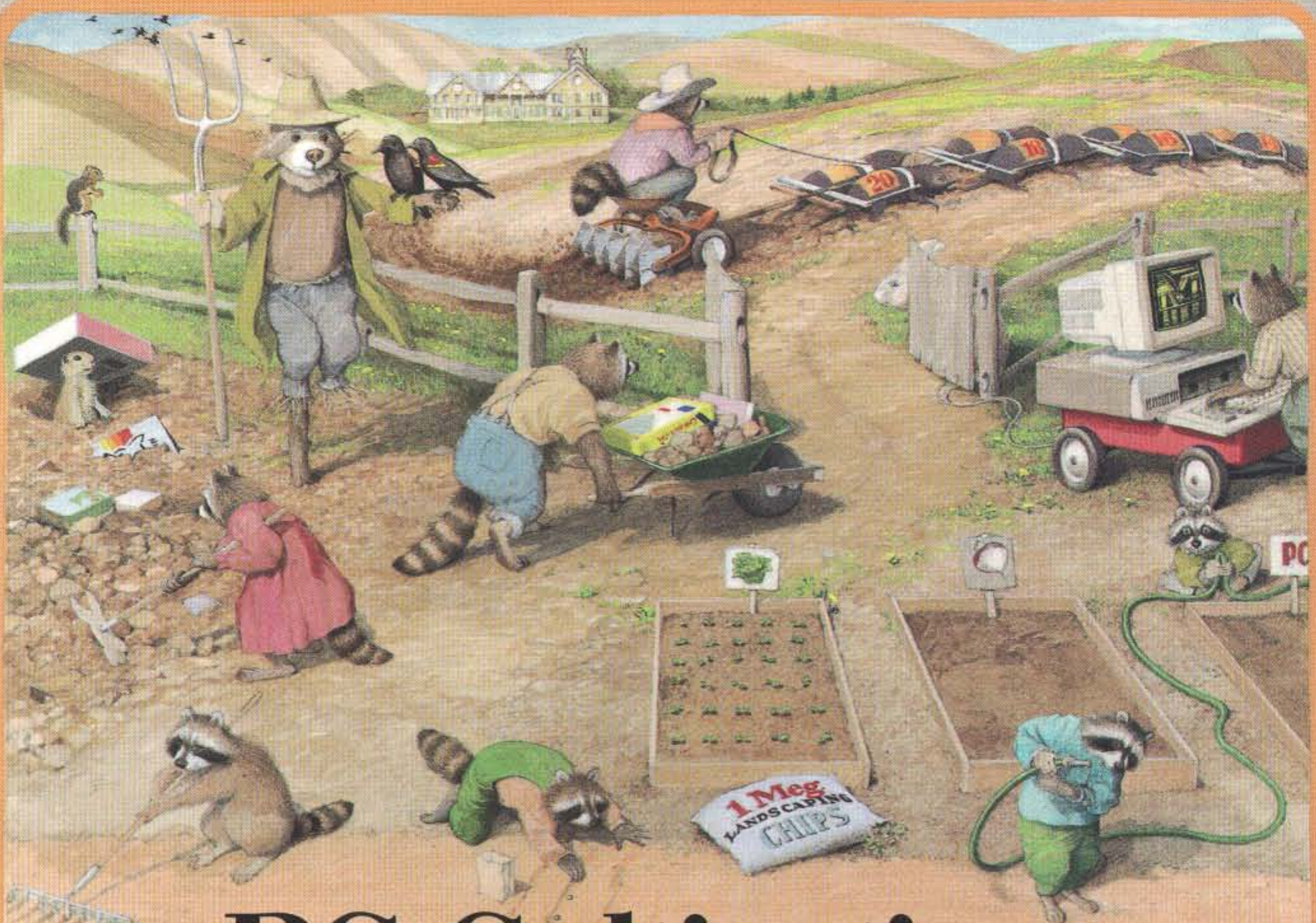
Intel ... 5 years
Connection CoProcessor–Award winning fax-modem includes a free copy of Fax-it software from Intel. Send and receive information in the background from within many popular applications. New low price .... **$529.**

HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

AST Research ... 2 years
1299 SixPakPlus 384k C/S/P .... 189.
4107 RAMpage Plus 286 512k......... 419.
Brother International ... 1 year
5787 HL-8e Laser Printer............ 1799.
5788 HL-8Ps PostScript Laser Printer . 2949.
Compucable ... 2 years
1604 2-Position switch box .... 25.
1605 3-Position switch box .... 35.
Corvus ... 1 year
6184 ReadyNet Starter Kit .... 319.
6183 ReadyNet Add-On Kit .... 165.
Cuesta ... 1 year
1608 Datasaver 400 Watt *(power backup)* 429.
Curtis ... lifetime
1690 Diamond Plus SP-1+ .... 41.
1694 Emerald SP-2 .... 36.
1707 Ruby SPF-2 *(6 outlets)* .... 55.
1708 Ruby-Plus SPF-2 Plus........... 65.
Diconix ... 1 year
5655 150 Plus Printer *(Parallel)*........ 359.
Epson ... 1 year
We are an authorized Epson Service Center.
1906 FX-850 *(80 col., 264 cps, 9 pin)*... 369.
1904 FX-1050 *(136 col., 264 cps, 9 pin)*. 479.
5183 LQ-510 *(80 col., 180 cps, 24 pin)*.. 349.
1930 LQ-850 *(80 col., 264 cps, 24 pin)* . 519.
1917 LQ-1050 *(136 col., 264 cps, 24 pin)* 725.
4116 LQ-2550 *(136 col., 333 cps, 24 pin)* 989.
5184 LX-810 *(80 col., 180 cps, 9 pin)* ... 199.
1052 Printer-to-IBM cable *(6 feet)*....... 15.
5th Generation ... 1 year
3952 Logical Connection 512k......... 529.
Hayes ... 2 years
2307 Smartmodem 2400 .... 349.
2308 Smartmodem 2400B *(w/Smartcom II)* 249.

PC CONNECTION®



PC Cultivation.

Silicon salad days.
(Or, how we mind our Peas & Cukes.)

Way up north in the fertile crescent of Marlow, NH (pop. 562), we know how to dig down deep. Which is pretty difficult (even for our celebrated 20 mole team) since the bedrock's just inches below the surface and the growing season's shorter than the day is long. But, with the winds of change blowing non-stop through the micro fields, you can't just scatter your seed any which way. You have to put down roots! We ought to know—we were the first company to sell peripherals and software exclusively for IBM personal computers. So when customers call us for product specs, prices, or technical assistance, they're dealing with a company that has its paws (and peas) planted firmly in the ground.

A window-based system you can grow with.

Up here in Marlow, our imagination isn't the only thing that's fertile. In fact, it's small potatoes compared to our PC Connection Mint Garden which comes complete with soil and seeds for growing a luscious crop of Spearmint, Peppermint and Lemon Balm right on your favorite window. Put a fresh sprig in your favorite beverage and we're sure it will add a delightful *je ne sais quoi* (which means that we have no idea what it will add—but it'll taste good). It's free to everyone who places an order of $500 or more between now and June 30.

Grow your own in a PC Connection Mint Garden. Offer not available outside the Continental U.S. or to accounts on net terms. One per customer.

PC CONNECTION®

Don't get fooled again.

IOMEGA ... 1 year

5116 Bernoulli II Single 44 Meg Internal $995.
5117 Bernoulli II Dual 44 Meg External 1969.
5113 44 Meg Cartridge Tripak *(5¼")* . . . 249.
2499 PC2 Card *(controller required)* . . . 169.

Mountain Computer ... 1 year

2917 40-60 Meg Internal Tape Drive. . . . 379.
5502 83-152M Ext. Tape Drive. . . . . 759.
5500 83-152M Int. Tape Drive . . . . 629.
6153 DC2120 Cartridge *(5 pack)* . . . . 135.
5190 DC2000 Pre-formatted Cartridges *ea.* 35.

Pacific Rim ... 1 year

5010 1.2 Meg External *(for PS/2's)* . . . . . 215.
6602 1.44 External *(for PC/XT/AT)* . . . . . 239.

Plus Development ... 2 years

3105 Hardcard 20 Meg *(49 ms)*. . . . . . . 529.
3106 Hardcard 40 Meg *(28 ms)*. . . . . . . 599.
6424 Hardcard II 80 Meg *(19 ms)* . . . . . 699.

Seagate ... 1 year

FREE PCTV® Hard Drive Installation Tape with purchase of 20, 30 or 40 Meg Seagate drive for the IBM PC (not for AT). Beta or VHS.

2285 20 Meg Internal Hard Drive ST225 *(w/controller and cables, 65 ms)* . . 275.
2286 30 Meg Internal Hard Drive ST238 *(w/controller and cables, 65 ms)* . . 289.

Practical Peripherals ... 5 years
2400SA MNP–Fully supports error-free MNP Level 5 data transmission, giving you more confidence in your communications. Also supports Hayes compatible 2400 bps standard operation. . . . . $209.

4554 40 Meg Int. HD ST251-1 (28 ms) . . 359.
2287 40 Meg Int. HD for PC ST251-1 *(w/controller and cables, 28 ms)* . . 419.
4624 80 Meg Int. HD ST4096 (28 ms) . . 619.

TEAC ... 1 year

4950 PC, XT 360k Drive *(5¼")* . . . . 79.
4951 720k Drive *(specify XT or AT, 3½")* . 79.
4670 1.44 Meg Drive for XT *(3½")*. . . . . . 99.
4326 1.44 Meg Drive for AT *(includes Bastech software utilities, 3½" copy prot.)* . 119.

MISCELLANEOUS

Checkfree

6360 CheckFree Xpress . . . . 25.

CompuServe

1676 CompuServe Information Service . . 24.

Cables ... lifetime

1019 Smartmodem-to-AT cable *(10 feet)* $15.
5511 Right Angle Printer cable *(6 feet)* . . . 15.
1050 Parallel Printer cable *(15 feet)* . . . . . 19.

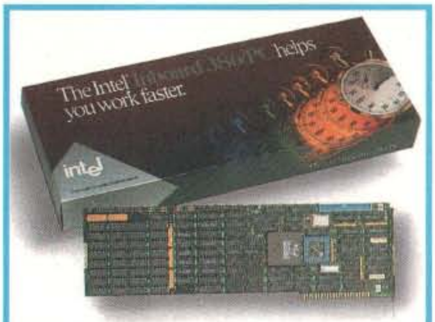
DISKS

All disks have a lifetime warranty.

5¼" DS/DD Disks *(360k)*

3291 Sony *(10 disks per box)* . . . . 12.
2789 Maxell MD2-D *(10 disks per box)* . . . 13.

XTREE ... NCP
▣ *XTreePro Gold 1.3*–A treasure of advanced disk management features–Directory Tree Display, Application Menus, Archive Management, Autoview & Enhanced View. Single keystroke commands for all operations. . . . . $75.



Intel ... 5 years
Inboard 386/PC–Brings advanced computing power to your PC/XT system. Includes 16Mhz 80386 processor and 1Mb RAM. Flexible 32-bit memory expansion options are also available . . . . $579.

5¼" DS/HD Disks *(1.2 Meg)*

3292 Sony *(10 disks per box)* . . . . 19.
2790 Maxell MD2-HD *(10 disks per box)* . 19.

3½" DS/DD Diskettes *(720k)*

3297 Sony *(10 disks per box)* . . . . 14.
2792 Maxell *(10 disks per box)*. . . . . 15.

3½" DS/HD Diskettes *(1.44 Meg)*

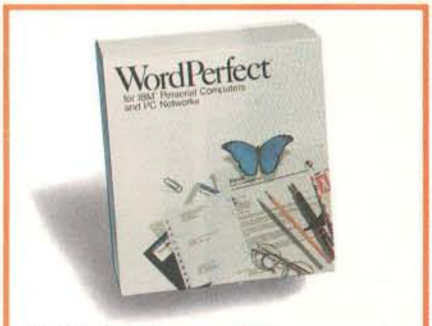
3298 Sony *(10 disks per box)*. . . . . 29.
2793 Maxell *(10 disks per box)*. . . . . 29.

MEMORY

3248 256k DRAMs *(120 nanosecond)* . . . call
4366 1 Meg x 9 SIMMs *(100 nanosecond)* call
5510 1 Meg x 9 SIMMs *(80 nanosecond)* call
5746 1 Meg Chips *(80 nanosecond)* . . . . call

OUR POLICY

- We accept VISA and MASTERCARD only.
- No surcharge added for credit card orders.
- Your card is not charged until we ship.
- If we must ship a partial order, we never charge freight on the shipment(s) that complete the order (in the U.S.).
- No sales tax.
- All U.S. shipments insured; no additional charge.
- APO/FPO orders shipped 1st Class Mail.
- International orders U.S. $250 minimum.
- Upon receipt and approval, personal and company checks now clear the same day for immediate shipment of your order.
- COD max. $1000. Cash, cashier's check, or money order.
- 120 day limited warranty on all products.*
- To order, call us Monday through Friday 9:00 AM to 1:00 AM, or Saturday 9:00 AM to 5:30 PM. You can call our business offices at 603/446-3383 Monday through Friday 9:00 AM to 5:30 PM.



WordPerfect Corp. ... NCP
☐ *WordPerfect 5.1*–Mix both text and graphics with this "high-end" word processor/ publisher. Multiple new features including "hot links" to 1-2-3, Excel, and PlanPerfect along with networking–all built in . $265.

SHIPPING

Note: Accounts on net terms pay actual shipping.

Continental US:

- For heavy hardware items such as printers, monitors, Bernoulli Boxes, etc. pay actual charges. Call for UPS 2nd-Day & Next-Day-Air.
- For all other items, add $3 per order to cover UPS Shipping. For such items, we automatically use UPS 2nd-Day-Air at no extra charge if you are more than 2 days from us by UPS ground.

Hawaii:

- For monitors, printers, Bernoulli Boxes, computers, hard drives, and power backups, actual UPS Blue charge will be added. For all other items, add $3 per order.

Alaska and outside Continental US:

- Call 603/446-3383 for information.

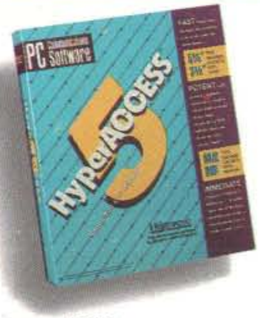
PC CONNECTION®

to make the best of both.

Intel ... 5 years
2400EX MNP Modem–The newest member of Intel's modem family. MNP/Level 5 provides error-correction for reliable communications, as well as data compression for faster data throughout .... $229.

Hercules ... 2 years
2318 Graphics Card Plus .... 189.
Hewlett-Packard ... 1 year
6583 Laserjet II *(w/toner)* .... 1739.
6582 Laserjet IIP *(w/toner)* .... 1039.
6581 Deskjet Plus *(w/ink cartridge)* .... 719.
Intel ... 5 years
4696 2400B Internal Modem .... 159.
2352 2400B Internal Modem 2 *(for PS/2)* 249.
5119 2400 Baud External Modem ..... 179.
6420 2400EX MNP Modem .... 229.
2346 Inboard 386/PC w/1 Meg *(w/free Ami)* 579.
4266 Above Board Plus 512k .... 419.
4267 Above Board Plus I/O 512k ...... 449.
5336 Above Board Plus 8 2 Meg ...... 599.
5342 Above Board Plus 8 I/O 2 Meg ... 629.
4272 Above Board 2 Plus 512k .... 469.
5396 Above Board MC 32 0k .... 359.
4275 Connection CoProcessor *(w/Fax-it)*. 529.
4857 Visual Edge *(graphics enhancement for the HP LaserJet II)* .... 449.
MATH COPROCESSORS
2370 80287-8 *(for 8 MHz 80286 CPU's)* . 199.
2369 80287-10 *(for PS/2 Models 50 & 60)* 229.
4750 80387SX *(for 80386SX CPU's)* .... 309.
2371 80387 *(for 16 MHz 80386 CPU's)* .. 349.
2372 80387-20 *(for 20 MHz 80386 CPU's)* 399.
Kensington Microware ... 1 year
2582 Masterpiece Plus .... 109.
5697 Expert Mouse *(Trackball for PS/2)* . 115.
Key tronic ... 3 years
4518 101 Plus Keyboard .... 99.
Kraft ... 5 years
5801 New Game Adapter *(2 game ports)*. 27.
5800 3 button Thunder Joystick .... 29.
5802 Trackball .... 69.
Logitech ... limited lifetime
5464 Series 2 Mouse *(C9 for PS/2's)* .... 69.
5151 HiREZ Mouse *(C9)* .... 85.
6029 Trackman *(Trackball) serial* 85. *bus* 89.
4297 ScanMan Plus *(hand scanner)* ... 185.
Micron Technology ... 2 years
6005 Ascend 4 Meg Brd. for Compaq 386 699.
6013 Beyond Mem. Brd. for Model 50 *(512k)* 359.

Microsoft ... lifetime
2897 Mouse with Paintbrush .... $109.
2898 Mouse with Windows 286 2.1 .... 139.
MicroSpeed ... 1 year
6007 PC-TRAC Trackball *serial* 75. *bus* 85.
6010 FastTRAP 3D Trackball *serial* 99. *bus* 109.
Mouse Systems ... lifetime
5845 White Mouse *(bus or serial)* .... 69.
5997 Trackball *(1 yr. wrnty.) serial* 75. *bus* 85.
4306 PC Mouse II w/PC Paint+ .... 89.
NEC ... 2 years
4799 Multisync 2A *(VGA Monitor)* ..... 499.
5085 Multisync 3D Monitor .... 689.
Orchid Technologies ... 4 years
4690 ProDesigner VGA *(800 x 600)* .... 249.
PC Power & Cooling Sys. ... 1 year
REPLACEMENT POWER SUPPLIES
3202 Turbo Cool 150 *(25° - 40° cooler)* 129.
3200 Silencer 150 *(84% noise reduction)* 115.



Hilgraeve ... NCP
HyperACCESS/5 1.0–Blasts data through your modem faster than any other program. Potent, agile, civilized. An automation breakthrough ... it learns your work! Contains versions for DOS and OS/2 .... $115.

Practical Peripherals ... 5 years
3101 1200 Baud Internal Modem ...... 69.
3100 1200 Baud External Modem *(mini)* . 77.
3103 2400 Baud Internal Modem ..... 139.
3102 2400 Baud External Modem ..... 179.
5286 2400 Baud Int. MNP Modem *(Lev. 5)* 175.
5285 2400 Baud Ext. MNP Modem *(Lev. 5)* 209.
4542 2400 Baud Internal Modem for PS/2 . 229.
Safe Power Systems ... 2 years
4561 Safe 250W *(standby power bkup)* 249.
4562 Safe 425W *(standby power bkup)* 369.
SOTA Technology ... 2 years
5111 SOTA 286i-12 *(12 MHz accelerator)* 269.
5402 SOTA 386i-16 *(16 MHz accelerator)* 389.
Targus ... lifetime
4899 Nylon Laptop carrying case ...... 55.
6037 Premier leather carrying case .... 199.

1-800/776-7777

MMC

PC Connection 710B
6 Mill Street
Marlow, NH 03456
SALES 603/446-7721 **FAX** 603/446-7791

TheComplete PC ... 2 years
TheComplete Communicator–It's a 9600 bps fax. It's a 2400 bps modem. It's a sophisticated voice messaging and processing system. It's a scanner port. It's TheComplete solution! .... $559.

TheComplete PC ... 2 years
5598 TheComplete Half Pg. Scanner 400 189.
5140 TheComplete Page Scanner ...... 549.
4887 TheComplete Fax 9600 .... 429.
5828 TheComplete Communicator ..... 559.
Toshiba ... 1 year
3684 T1000 Laptop *(80C88, 6.4 lbs.)* ... 669.
6332 T1000SE Notebook Laptop *(5.9 lbs.)*. 1269.
4958 T1600 Laptop *(12 MHz, 20 Meg)* . 3249.
Tripp Lite ... 2 years
6201 Isobar 8 *(8 outlets, 12 ft. cord)* ..... 69.
6019 LS 600 Line Stabilizer .... 85.
6018 LC 1200 Line Conditioner .... 159.
Video 7 ... 7 years
5883 1024i VGA *(includes 512k)* ...... 289.
4931 VRAM VGA 512k .... 449.

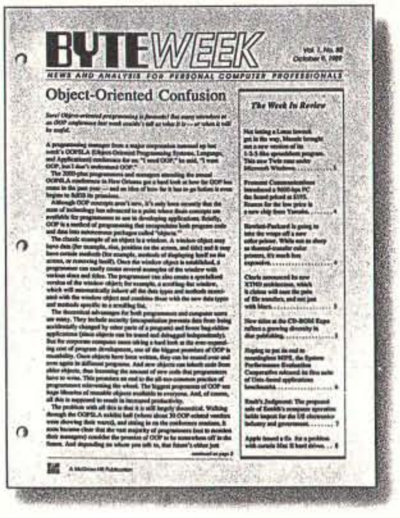
DRIVES

DTC ... 1 year
6248 AT Floppy/Hard Drive Controller .. 129.

Targus ... lifetime
Premier Leather Carrying Case–Establishes a new standard of quality for business related luggage. This dual purpose case combines a luxurious, feature rich, leather briefcase together with a functional laptop carrying case .... $199.

PC CONNECTION®

The Cream. The Crop.



There are plenty of places to get information in this industry. Too many. But if you want the best quality information, there's only one that rises to the top: BYTE*WEEK*.

BYTE*WEEK* is a weekly newsletter from the same professionals who produce BYTE Magazine. Each week, the most important news and information from the previous week is presented in a readable and concise manner. BYTE*WEEK* offers you what no other publication can: timely news on the rapidly-evolving computer industry as it happens with the interpretation and evaluation that only BYTE's experienced editorial staff can provide.

Subscribe now and take advantage of a special subscription rate of $395 ($495 outside the U.S. and Canada). Your subscription to BYTE*WEEK* also includes a free subscription to BIX, BYTE's exclusive on-line conferencing system. *Don't miss this opportunity!*

For fastest service, call toll-free **1-800-258-5485** (in N.H., call **603-924-9281**) and charge to a major credit card or we'll bill you.

BYTEWEEK McGraw-Hill

One Phoenix Mill Lane, Peterborough, NH 03458.

BYTE*WEEK* offers a money-back guarantee if you are not completely satisfied.

Clip Coupon Here

❑ **YES! Sign me up as a subscriber to the Cream of the Crop, BYTE*WEEK* at the special subscription rate of $395 a year for 50 issues ($495 a year outside the U.S. and Canada).**

Name ______________________
Title ______________________
Company ______________________
Mail Address ______________________
City/State/Zip ______________________
Business Phone ______________________

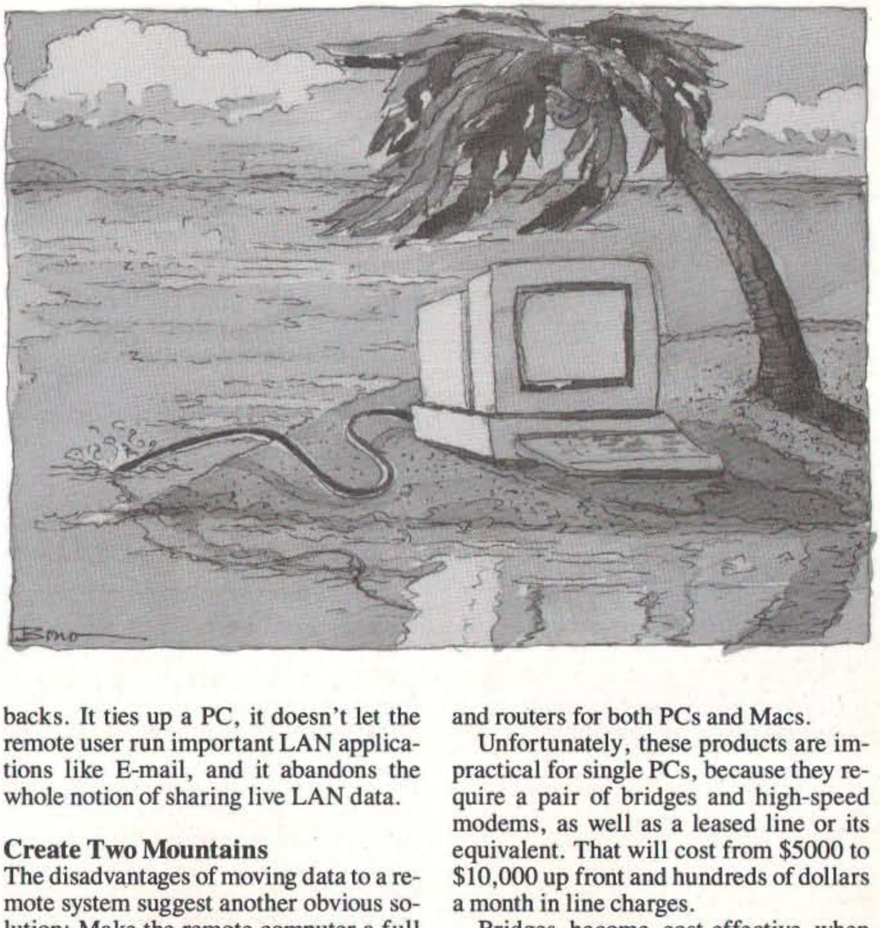
❑ MasterCard ❑ VISA
❑ Check enclosed ❑ Bill me

Card # ______________________
Exp. ______________________
Signature ______________________

BYTEWEEK McGraw-Hill One Phoenix Mill Lane
Peterborough, NH 03458

FARAWAY LANs

LAN remote-access schemes are the next-best thing to being there



The last few years have tugged many of you in two directions at once. LANs have drawn you to central locations, while the growing use of portable computers and the move toward people working at home have pushed you geographically apart.

We're suffering from this dilemma ourselves. Our main LAN, with its crucial data and applications, is in our lab at Mark's house. We currently run NetWare on that LAN because it lets us link the 20 or so Macintoshes and PCs in the lab to the same servers. The problem is that, while we often work together in the lab, Bill also often works in his home office. We also spend a lot of time traveling, usually armed with one of the eight or so Mac and PC portables in the lab.

A recent bout of travel, coupled with some bad weather, forced us to consider ways to get to the lab's LAN from other locations. While our situation is admittedly unusual (few organizations have a 10-to-1 computer-to-employee ratio), the solutions that we found will work for any group that needs to provide remote access to its LANs.

Move the Mountain

The most obvious solution is to move any LAN data you need to a remote system. Just run a communications program and a modem on a machine on the LAN, and use that machine to transfer files. All you need is a reasonable file transfer protocol, such as ZMODEM, XMODEM, or Kermit. Until fairly recently, this was our answer: Kermit in server mode on a PC.

But this approach has several drawbacks. It ties up a PC, it doesn't let the remote user run important LAN applications like E-mail, and it abandons the whole notion of sharing live LAN data.

Create Two Mountains

The disadvantages of moving data to a remote system suggest another obvious solution: Make the remote computer a full participant in the LAN, so that it can share LAN data in the usual ways. Basically, you extend the LAN over telephone lines by using a LAN spanning product such as a bridge or router. Then neither the remote system nor any of the other machines on the LAN, including the server, are aware that the LAN is not all in one location.

On the remote side, you connect a PC to a null Ethernet (or another network), which in turn connects to the bridge or router. On the LAN side, you connect another bridge or router to the Ethernet. Many vendors now offer remote bridges and routers for both PCs and Macs.

Unfortunately, these products are impractical for single PCs, because they require a pair of bridges and high-speed modems, as well as a leased line or its equivalent. That will cost from $5000 to $10,000 up front and hundreds of dollars a month in line charges.

Bridges become cost-effective when you need to connect a remote group of PCs to a central LAN because you can spread the cost over all the remote PCs. Bridges work best when most of the LAN traffic is on the two separate LAN segments, with only occasional messages passing between them.

Move Mohammed

The final solution is to leave the data where it is. You just dedicate a local PC to the remote user and run a remote-access program on that PC. Those programs run the LAN applications on the

continued

ILLUSTRATION: BONO MITCHELL © 1990

ITEMS DISCUSSED

NETremote+ ....$350 per server
Brightwork Development, Inc.
766 Shrewsbury Ave.
Jerral Center West
Tinton Falls, NJ 07724
(800) 552-9876
(201) 530-0440
Inquiry 1071.

QL 1002 (for the PC)..........$645
QL 2201A (for the AT)....... $1125
Cubix Corp.
2800 Lockheed Way
Carson City, NV 89706
(702) 883-7611
Inquiry 1072.

Timbuktu/Remote .. $195 per Mac
Farallon Computing, Inc.
2000 Powell St.,
Suite 600
Emeryville, CA 94608
(415) 596-9000
Inquiry 1073.

local PC and send to the remote PC only the screen output of those applications. The idea of transferring only screen information is not new to LANs; PC and Mac remote-access programs have been around for years.

One interesting LAN remote-access product is NETremote+ from Brightwork Development of Tinton Falls, New Jersey. NETremote+ adds LAN capabilities to Co/Session, a PC remote-access package from Triton Technologies of Red Bank, New Jersey.

NETremote+ runs as a TSR program on the slave PC on the LAN. It detects screen changes as they happen and sends them to the remote PC. The remote PC runs a special, complementary terminal emulator that uses those changes to update the screen. That emulator also sends any keystrokes from the remote PC to the LAN slave PC, making it appear as if you had typed them in on the slave. The program can even send graphics screens, albeit slowly.

Co/Session provides most of these features. NETremote+ goes a step beyond normal remote access by letting the slave PC control any other PC on the LAN.

The result of running NETremote+ is that the remote PC acts as if it were the slave PC on the LAN.

While fewer remote-access products exist for the Mac than for the PC, the Mac products work in basically the same way. Timbuktu/Remote, from Farallon Computing of Emeryville, California, is a popular Mac remote-access program. Because it works with Macs, Timbuktu/Remote sends mouse commands as well as keystrokes to the slave Mac. It transfers screen images as QuickDraw commands; this approach speeds graphics transfers and lets the remote and slave Macs use different-size monitors.

One More Wrinkle

The above approach still requires a dedicated PC or Mac, with a modem, to handle the telephone connection. That's fine for folks who need to get to their office systems from a home computer or a laptop on the road, but it means buying another whole system if the remote user doesn't normally have an office PC. That additional slave PC costs extra money and consumes precious space.

Cubix Corp. addresses this problem by putting a dedicated PC into a PC-based server. The firm's PC-on-a-card product requires only a standard AT slot and is available in both NEC V40 and 286 versions. It lets you put up to four PCs on a card and up to four such cards in one server—so you can have as many as 16 PCs hiding in your server. This approach can save a lot of desk space.

We put one of Cubix's QL 1002 cards, which contains two V40 processors, in our Samsung NetWare server. (The card will also work with Network OS.) The server's standard AT bus acts as the "network" between the server's CPU and the CPU on the card. The QL 1002 includes NetWare drivers for this "bus" network, so neither the server nor the PC can tell that it's not just another system on the LAN. (The server sees the bus as just another LAN medium, much as a single NetWare server can contain and work with both Ethernet and Token Ring cards.)

The PCs on the card use a NetWare shell that also comes with the card. You also have to create a boot-image file for these PCs, such as we described in our December 1989 column "When One Drive Is Enough." You then boot the PC-on-a-card from the server. By attaching a terminal to it, you can operate that PC just as if it were a diskless workstation.

You also can use the PC-on-a-card to solve our problem by running a remote-access package on it. You can make the entire process automatic by starting that program in the PC-on-a-card's AUTOEXEC.BAT file in the boot image. Attach an external modem to the card (which has the necessary serial ports), and you can access the PC-on-a-card

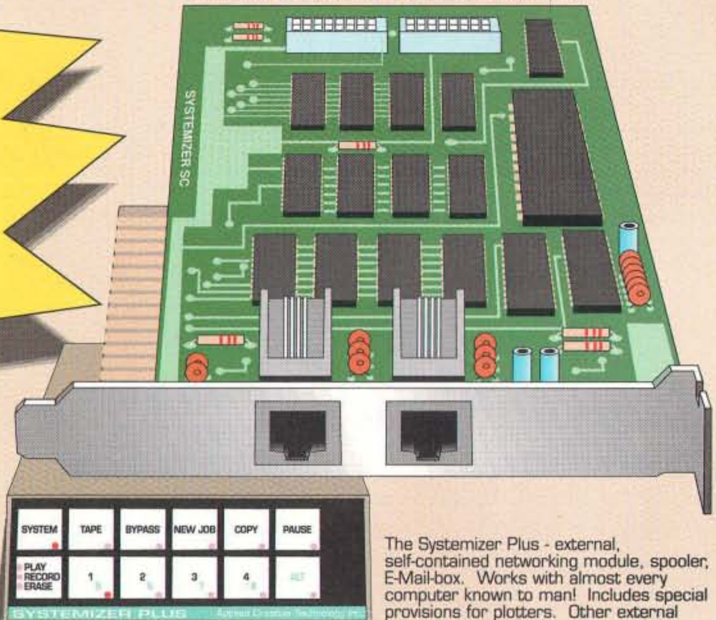
continued

NEW Slot Card Systemizer SC!

Systemizing

The truly universal LAN alternative...

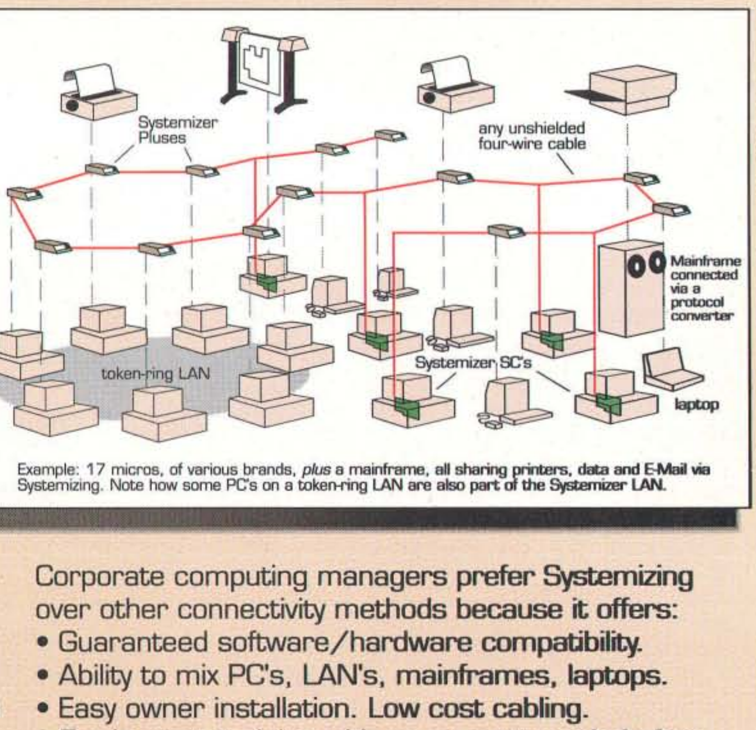
The Systemizer SC - features memory resident printer controller, spooling, E-Mail and file transfer. For all MS-DOS® PC's and compatibles.



The Systemizer Plus - external, self-contained networking module, spooler, E-Mail-box. Works with almost every computer known to man! Includes special provisions for plotters. Other external models also available.

Up to 31 users can...

- Share Printers
- Share Plotters
- Share a Modem
- Exchange E-MAIL
- Transfer Datafiles



Example: 17 micros, of various brands, *plus* a mainframe, all sharing printers, data and E-Mail via Systemizing. Note how some PC's on a token-ring LAN are also part of the Systemizer LAN.

Systemizing has become the connectivity standard at many of the world's largest corporations and throughout the federal government. Ten's of thousands are already in use. The new Systemizer SC is the latest model in Applied Creative Technology's line of Systemizing products, and it delivers what 95% of corporate computer users want from a Local Area Network— at far less cost and complexity, and yet with much more versatility.

Corporate computing managers prefer Systemizing over other connectivity methods because it offers:

- Guaranteed software/hardware compatibility.
- Ability to mix PC's, LAN's, mainframes, laptops.
- Easy owner installation. Low cost cabling.
- 5 min. user training with no support needed after.
- Flexibility; readily accomodates growth and changes.
- Distributed processing for high speed and reliability.

And with the new SC, everyone can afford to Systemize!

Call 1-800-433-5373 to get a FREE demo!

The CONNEXPERTS℠
A Division of Applied Creative Technology Inc.
8333 Douglas Ave., Suite 700
Dallas, Texas 75225 U.S.A.
(214) 739-4200

from a remote PC just as if you were using a regular PC on the LAN.

The PC-on-a-card approach saves both physical space and network bandwidth. You can use it whenever you would use a dedicated PC on the LAN; for example, it makes a nice asynchronous modem pool server. But there are some drawbacks to using a PC-on-a-card. These cards can't work with any other boards in the server because they see the server's bus as a network, not a normal bus. These boards cannot, therefore, work with such important server resources as 3270 gateways. The PC-on-a-card also isn't particularly cheaper than a dedicated inexpensive PC clone—Cubix's AT-on-a-card lists for more than $1100.

Line Problems

The solutions that we have described should sound familiar: We've just reinvented the minicomputer, complete with terminals (graphics terminals for Macs).

It shouldn't be surprising, then, that these techniques also suffer from the biggest problem plaguing minicomputer terminals—the speed of telephone lines. If you've ever used a minicomputer or an on-line service like BIX, you know that 2400 bps is slow. The problem is even worse for PCs and Macs, where applications update the screen constantly.

Higher-speed 9600-bps modems help quite a bit. CCITT V.32–class modems with V.42 data compression are even better. Still, even the best modem yields screen performance far below what you have come to expect from PCs. The 65,536-bps speed of ISDN will help even more, but remote access will probably never be as nice as being there.

The bottom line is that you sacrifice PC responsiveness to gain remote LAN access. As a result, for the foreseeable future, remote LAN access is best for occasional use for applications such as E-mail and data exchange. Save the heavy database work until you're in the office and can either sit down at your desktop LAN system or plug your laptop into a Xircom external Ethernet adapter or an AppleTalk connector. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

Hewlett-Packard's Laser Counterattack

With the introduction of the **LaserJet III**, Hewlett-Packard has thrown down the gauntlet, making it clear to competitors that it's not about to sit back and give others the advantage in the hot battle for laser-printer market share. The long-awaited successor to the venerable LaserJet Series II, the LaserJet III brings new meaning to the term "more for less," and it's sure to make users sit up and take notice. I certainly did.

HP claims that the LaserJet III is completely compatible with the Series II. So what's the big deal, besides a sleek new look? Well, there's plenty of cutting-edge technology under the hood.

If you've purchased a laser printer recently, you've probably found that few are very useful without a bunch of options. It's like buying a stripped-down car.

But HP has packed enough standard features into the LaserJet III to make it immediately useful. With a megabyte of RAM, I could print out a full page of graphics. Even more useful is the LaserJet III's selection of fonts. The 14 internal bit-mapped fonts are just the beginning. It also comes with CG Times and CG Univers typefaces from AGFA Compugraphic. Both typefaces come in regular, boldface, italic, and boldface italic. You can scale these eight fonts from ¼ point (too small to read) to 999.75 points (larger than a standard sheet of paper).

Thanks to the III's new PCL (Printer Control Language) 5, which incorporates vector graphics, those fonts can be stretched, rotated, and overlaid in addition to being scaled. All these features are impressive, but what places the LaserJet III in a solitary spotlight is a proprietary feature called *resolution enhancement.* Yes, it is still a 300- by 300-dot-per-inch printer, but HP has put a patented circuit before the print engine that makes all the difference. Resolution enhancement performs the tricky task of modulating the laser beam in the print engine, varying both the size and placement of the individual dots. It works strictly on the edges of graphics and characters, and it does a superb job of eliminating jaggies, the stair-step edges that are particularly noticeable on graphics and large fonts.

I noticed the difference on the first sheet I printed; the III's output has a pronounced crispness that's lacking on the output from other laser printers. Since resolution enhancement is also switchable (in case you're using add-in cards that depend on an unmodified print engine), I turned it off and printed a page of unenhanced graphics. The difference is striking, and, under a magnifying glass, the III's ability to produce what's effectively the look and feel of typeset quality is even more discernible.

While many laser printers are rated at 8 ppm, that's a theoretical maximum for plain text. The reality—especially for printing graphics—is often considerably less. But in the LaserJet III, HP has tweaked the hardware and software to make the data really move. The company claims overall I/O performance has been increased by nearly 50 percent. And although I didn't use any formal benchmarks, my subjective impression is that the LaserJet III gave my computer back to me (and started printing) considerably faster than the Series II. It was very noticeable when I printed graphics.

At $300 less than the LaserJet II, the LaserJet III's price is impressive.

You can use all the add-ons designed for the Series II plus some new ones. Add a 2-MB memory board, a PostScript-emulation cartridge, and an AppleTalk interface, and for $4355, you have a full-fledged Macintosh laser printer for considerably less than Apple's own. In addition, you get resolution enhancement.

I was disappointed that the LaserJet III lacks a second paperfeed tray. But when you couple the printer's standard features, resolution enhancement, and rock-bottom price, the LaserJet III comes out as not only an unbeatable deal, but a truly trailblazing product. And since other laser-printer manufacturers will be burning the midnight oil to answer HP's challenge, the LaserJet III's ultimate feature may turn out to be "competition enhancement."

—Stan Miastkowski

THE FACTS

LaserJet III
$2395

Options:
1-MB memory board, $495;
2-MB memory board, $990;
PostScript cartridge, $695;
AppleTalk interface, $275.

Hewlett-Packard Co.
19319 Pruneridge Ave.
Cupertino, CA 95014
(800) 752-0900
Inquiry 985.

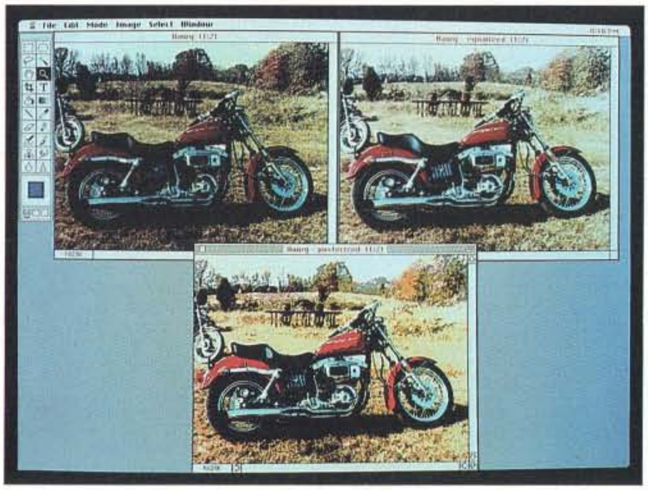
Photoshop Is Picture-Perfect

With the advent of 32-Bit QuickDraw and a variety of 24-bit color boards, Macintoshes can view and work with large images that contain millions of colors. This opens the door for Mac applications like Adobe's new **Photoshop**, which can perform the electronic equivalent of darkroom image manipulation on your Desktop.

Photoshop comes well-equipped to import, process, and export images from various computers. It reads PICT2, TIFF, MacPaint, PixelPaint, and the preview image in EPS files. Other files that it can handle are TGA (TARGA format), GIF, PIXAR, and Amiga IFF/ILBM files. For the hard cases, there's also a "Raw" option that lets you specify certain file characteristics so that Photoshop attempts to generate an image from the data. And Photoshop's list of image-saving formats is equally exhaustive. It has its own Photoshop format, plus PICT2, PICT2 resource, TIFF, EPS, Amiga IFF/ILBM, GIF, MacPaint, and PIXAR formats.

Photoshop supports black-and-white bit-mapped, gray-scale, RGB, HSL (hue, saturation, and lightness), HSB (hue, saturation, and brightness), and CMYK (cyan, magenta, yellow, and black) images. You can convert images between each image type, within limits.

A variety of tools on a floating palette window provides all sorts of ways to work with an image. There are painting, viewing, editing, and selecting tools. You can also make color corrections to an image by adjusting its brightness, contrast, and color balance. You can flip, rotate, and skew images. There's a host of filtering functions that blur or sharpen an image, apply high-pass filtering, diffuse and despeckle it, or add noise. These changes are applied to the entire image or just the portion that you select with one of the selection tools.



Photoshop can print an image using CMYK-process colors or Color PostScript, or as a halftone, where you can specify the screen frequency, dot shape, and screen angle. Images can be printed as composites (all the colors together) or as separations. Photoshop can send the pixel data either as ASCII hexadecimal (the standard PostScript method) or in binary form for speed.

I used a beta version of Photoshop 1.0b6 on a Mac II equipped with 4 megabytes of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a 19-inch SuperMac monitor and Spectrum/24 Series III video board. I worked with an assortment of scanned images, ranging from 8 to 24 bits deep and 75 to 300 dots per inch, that I acquired from either Howtek or Sharp color scanners.

Photoshop's user interface is very slick and clean: Adobe used Apple's MacApp object-oriented libraries to implement it. You can have multiple windows open, and each window's title descriptively names the image's source file, size ratio, and memory usage. Unlike some other image editors, Photoshop didn't care what the Mac's screen depth was: Whether it was 4 or 24 bits deep, Photoshop drew the images. Better still, with a 24-bit-deep display, you can open windows to the same image and place them side by side to compare the effects of color corrections—a very nice feature that I've yet to see elsewhere.

Photoshop is fast. It does not take long to open 24-bit PICT2 images. And it applies color modifications and rotations rapidly to an image; there was none of the dawdling that I've come to expect with PhotoMac 1.1. Photoshop had no problems importing a TIFF file from a NeXT Computer, and it accepted Amiga IFF and HAM files that I downloaded from BIX. For the HAM file, a dialog box informed me that the original image's pixels were rectangular and asked if it should rescale the image for the Mac's square pixels. It's small but significant touches such as these that save designers and illustrators headaches and that makes Photoshop a superior product.

I used Apple's LaserWriter 6.0 driver with a LaserWriter and a QMS-PS 810 Turbo laser printer to print images, with good results. Printing with binary encoding reduced the printing times by a third. Certain networks and printers choke on binary PostScript data, in which case you'll have to check ASCII encod-ing in the printer dialog box. Photoshop also implements its own virtual memory system so that you can work with files larger than physical memory.

This version of Photoshop looks excellent. The tools worked smoothly, and the virtual memory let me work on 6-MB files easily. If your work runs to heavy-duty image processing or color prepress, then Photoshop promises to be a must buy for the job.

—Tom Thompson

continued

THE FACTS

Photoshop
$895

Requirements:
Mac Plus, SE, SE/30, or II with 2 MB of RAM, System 6.0.3 or higher, and a hard disk drive.

Adobe Systems, Inc.
1585 Charleston Rd.
P.O. Box 7900
Mountain View, CA 94039
(800) 922-3623
Inquiry 986.

The No-Compromise Notebook Computer

For laptop systems—perhaps the most personal of personal computers—everybody seems to have strong opinions on what features ought to be included. We all have our own notions of the ideal display type, processor, hard disk size, weight, and, of course, price. In the past, the small size and weight required that you make some significant compromises. This has been particularly true for the lightweight notebook computers that have appeared recently. But fortunately, as time goes on, new systems exhibit fewer and fewer compromises. And the new Toshiba **T1200XE** is perhaps the first notebook system that frees you from any major compromise.

At first glance, it looks as if Toshiba has crammed all the goodies of its T1600 laptop into a notebook format. This is quite a feat, since the T1600 weighs almost 12 pounds, and the new T1200XE weighs in at less than 8 pounds, including a battery pack. Despite this rather low weight, the system includes a 12-MHz 286 processor, a 20-megabyte hard disk drive, a 3½-inch floppy disk drive, and a high-contrast LCD screen. There is even room inside for up to 5 MB of memory (1 MB is standard); this is important for OS/2 users. And while most companies charge more for their smaller systems, Toshiba has bestowed upon the T1200XE a price that is significantly lower than that of its older, larger relative, the T1600.

Of course, the new Toshiba computer does not set any records for low weight. Lighter laptops are available, notably the impressive Compaq LTE/286, which has the same features as the Toshiba system but weighs in at a full pound less.

Nevertheless, the T1200-XE has a larger screen, a more comfortable key-board, and a lower price tag.

In my test of a prototype T1200XE, the system performed quite well. Its large 640- by 400-pixel CGA-style backlit LCD is almost exactly like that of the T1600 and is a real pleasure to view. Likewise, the keyboard is almost an exact copy of that on the T1600 and is very easy to become accustomed to. The many T1000 users out there—including myself—should have no trouble at all easing into this system.

A somewhat hidden feature of the new system is a 100-pin connector on the back panel. Toshiba has stated that it will soon offer a "base station" for the T1200XE that will include, among other things, room for two full-size expansion slots.

Another nice feature of the back panel is an RGB monitor connector—important for those who need to make presentations or demonstrations.

Other hidden features of the system include Toshiba's traditional assortment of laptop frills. These include AutoResume, a feature that lets you turn the system on and immediately resume what you were doing when you last powered the computer down.

Toshiba has a number of interesting new laptops available. The new T1000SE and the T1000XE (with a hard disk drive) deserve particular note. I found these systems to be excellent, but some users may prefer a bit more power.

Eventually, we will probably see notebook systems based on the 386SX microprocessor. But until then, if you're going to hit the road and can't compromise on power—or anything else, for that matter—the T1200XE seems to be an excellent choice.

—Rich Malloy

THE FACTS

Toshiba T1200XE
$3999

Toshiba America
Information Systems
Computer Systems
Division
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000
Inquiry 987.

R:base Goes for the Gold

Ever since its first appearance, R:base's forte has been ease of use coupled with power. In its newest incarnation, **R:base 3.0** from Microrim, it is even easier to use and more powerful and comes with a raft of new features.

It's nearly impossible to list even a small fraction of the features available in an application package as sophisticated as R:base 3.0. Its menu interface is improved and now looks like those in other database packages. But overall, the software makes creating, editing, and doing real work with data much less of a chore than other database managers I've used.

While QBE (Query By Example) is a customary (and necessary) feature in all relational databases, R:base 3.0 adds a number of handy bells and whistles to it. In competing high-end packages, the all-too-necessary ability to browse through existing data—to mark, edit, or print needed information—isn't always easy. But R:base 3.0 has made browsing chores easy to do with just a few keystrokes.

Another time saver is R:base's ability to do global search and replace. By way of comparison, in Borland's Paradox 3.0, the only way to do a search and replace is by writing a custom utility using the package's proprietary language.

Most of the people who actually use databases in their day-to-day work aren't technically sophisticated. So in order to be truly powerful, a database manager must provide the ability for the resident database expert to create easy-to-use finished applications with custom forms and menus. R:base 3.0's application-generation facilities are some of the

continued

Embedded systems designers have already used **CrossCode C** *in over 577 different applications.*

CrossCode C has twelve important features to help you program your 68000-based ROMable applications

It's the one 68000 C compiler that's tailor-made for embedded systems development

CrossCode C is designed specifically to help you write ROMable code for all members of the Motorola 68000 family. It comes with these twelve special features to help you get your code into ROM:

1. A 100% ROMable Compiler: CrossCode C splits its output into five memory sections for easy placement into ROM or RAM at link time.

2. Integrated C and Assembler: You can write your code in any combination of C and assembly language.

3. Readable Assembly Language Output: The compiler generates assembly language code *with your C language source code embedded as comments*, so you can see each statement's compiled output.

4. Optimized Code: CrossCode C uses minimum required precision when evaluating expressions. It also "folds" constants at compilation time, converts multiplications to shifts when possible, and eliminates superfluous branches.

5. Custom Optimization: You can optimize compiler output for your application because *you* control the sizes of C types, including pointers, *floats*, and all integral types.

6. Register Optimization: Ten registers are reserved for your register variables, and there's an option to automatically declare all stack variables as *register*, so you can instantly optimize programs that were written without registers in mind.

7. C Library Source: An extensive C library containing over 70 C functions is provided in source form.

8. No Limitations: No matter how large your program is, **CrossCode C** will compile it. There are no limits on the number of symbols in your program, the size of your input file, or the size of a C function.

9. 68030 Support: If you're using the 68030, **CrossCode C** will use its extra instructions and addressing modes.

10. Floating Point Support: If you're using the 68881, the compiler performs floating point operations through the coprocessor, and floating point register variables are stored in 68881 registers.

11. Position Independence: Both position independent code and data can be generated if needed.

12. ANSI Standards: CrossCode C tracks the ANSI C standard, so *your* code will always be standard, too.

There's More

CrossCode C comes with an assembler, a linker, and a tool to help you prepare your object code for transmission to PROM programmers and emulators. And there's another special tool that gives you symbolic debugging support by helping you to prepare symbol tables for virtually all types of emulators.

CrossCode C is available under MS-DOS for just $1995, and it runs on all IBM PCs and compatibles (640K memory and hard disk are required). Also available under UNIX, XENIX, and VMS.

CALL TODAY for more information:

1-800-448-7733
(ask for extension **2003**)

Outside the United States, please dial

PHONE: **1-708-971-8170**
FAX: **1-708-971-8513**

SOFTWARE DEVELOPMENT SYSTEMS, INC.
DEPARTMENT 23
4248 BELLE AIRE LANE
DOWNERS GROVE, ILLINOIS 60515 USA

neatest I've seen. I was able to design a custom mailing-list application in a little over a half hour. (It took nearly a full day's work with Paradox.) R:base 3.0 also supports a mouse. And that made the job even easier.

For everyday applications, R:base's powerful built-in ability to handle a large variety of labels is particularly handy. And once I had designed the mailing-list application to my liking, I used the CodeLock utility to convert the application into a stand-alone executable file.

Of course, the R:base 3.0 developers haven't forgotten the needs of dyed-in-the-wool database aficionados. The package's command language has been extended and enhanced with a number of new features. Most notable is a selection of ANSI Level II Structured Query Language commands. And for those of us for whom SQL is still an inscrutable mystery, I found R:base 3.0's extensive on-line help (called Prompt by Example) an invaluable learning tool that saved me considerable time and effort.

While R:base users are an enthusiastic lot, the package has never managed to make much of a dent against the heavyweights in the heavily competitive RDBMS market. In many ways, R:base 3.0 has taken a giant leap ahead of its competition, but it's still going to be a tough horse race for Microrim.

—Stan Miastkowski

THE FACTS

R:base 3.0
$725 (Network Six-Pack, $995; unlimited network license, $2695)

Requirements:
IBM PC, AT, PS/2, or compatible with 640K bytes of RAM, DOS 3.0 or higher, and a hard disk drive (with at least 4 megabytes of available space).

Microrim
3925 159th Ave. NE
P.O. Box 97022
Redmond, WA 98073
(206) 885-2000
Inquiry 988.

Lotus Goes Graphical

Lotus's snazzy new three-dimensional **Lotus 1-2-3/G** spreadsheet for Presentation Manager (PM) takes full advantage of OS/2's power, yet manages to retain compatibility with earlier character-based versions of 1-2-3. It also upholds an OS/2 truism: If you want multitasking, large memory, and the ease of use of a graphical user interface (GUI), you must be prepared to pay a price in hardware and performance.

Many of the program's advantages (i.e., WYSIWYG screens and live links to external files) accrue from OS/2 and PM. To make the transition to OS/2 even more appealing, Lotus greatly improved graphics and added 20 levels of undo. A utility called the Solver lets you model equations for optimal results based on a defined set of inputs and criteria.

Lotus 1-2-3/G is based on the feature set and 3-D model used in 1-2-3 release 3.0. A single spreadsheet file can contain up to 256 layers, and normal @ functions and ranges can stretch along the *z*-axis.

In addition, you can open up to 16 spreadsheet and graphics windows on the desktop at the same time. Because OS/2 is multitasking, you can recalculate a spreadsheet in one window while printing from another and editing in a third.

One of 1-2-3/G's strengths is that it conforms to PM standards while preserving the keystroke sequences that are familiar to current 1-2-3 users. To mimic 1-2-3's hierarchical menu in the GUI environment, Lotus devised enhancements to PM, including cascading menus and multiple-choice dialog boxes.

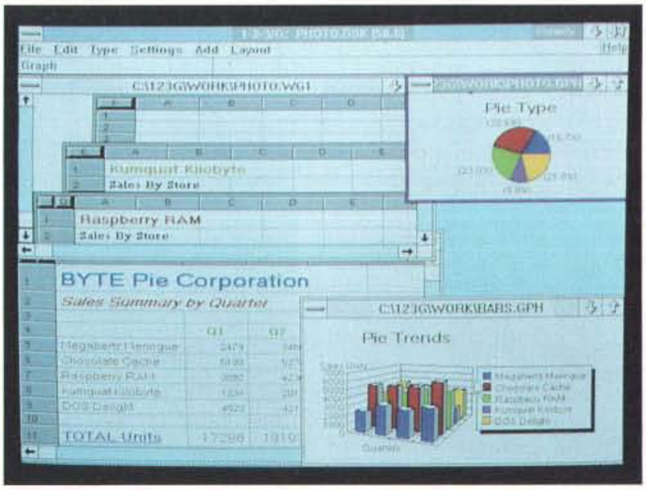
Among the new graphics features are 3-D bar graphs and the user's ability to directly manipulate graphs with the mouse. Most of the new features are in the Graph Tool, a separate part of the program from the main menu.

With the powerful Solver utility, you can model problems backward to obtain a desired output. Instead of trying repeated what-if scenarios, you enter variables and constraints into the spreadsheet and let the 1-2-3/G Solver feature optimize an output like profit or resource utilization.

I was very impressed with most capabilities of 1-2-3/G. My only reservation concerned a conceptual clash between the 3-D model of release 3.0 and the windowing model of PM. In maintaining file and keystroke compatibility, I don't think 1-2-3/G makes the best use of the mouse. This is clearest when a window contains stacked sheets in the style of release 3.0.

While PM lets you click between windows, resize them, and so forth, sheets within a window don't follow the same rules—in fact, you can't even zoom in on them as you can in release 3.0. As a result, you spend more time with the keyboard than the mouse, but for 1-2-3 traditionalists, this is probably preferable anyway. ■

—Andrew Reinhardt

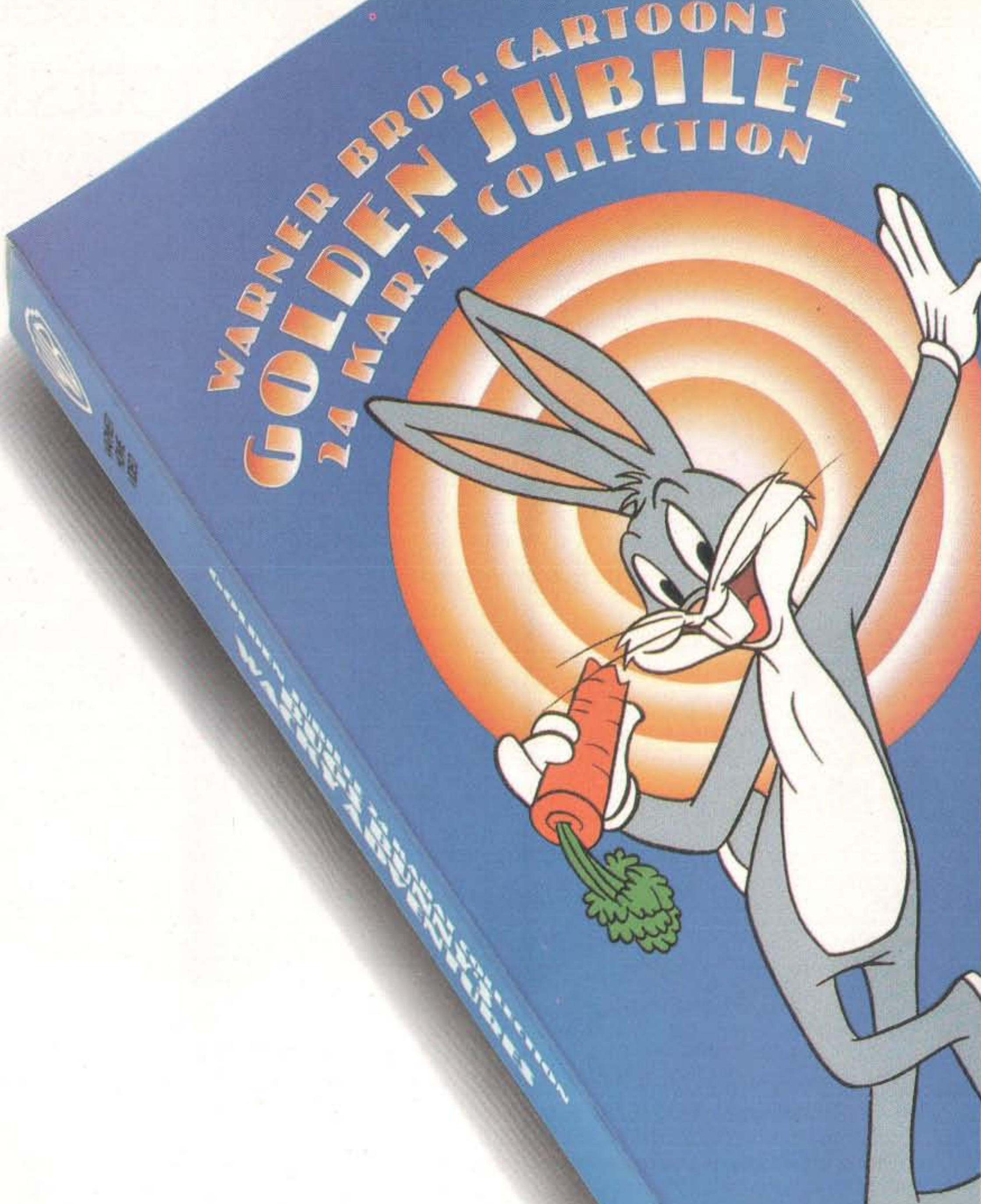


THE FACTS

Lotus 1-2-3/G
(price not available)

Requirements:
A 386 computer with 4 megabytes of RAM, OS/2 1.1 or 1.2 Standard or Extended Edition, a hard disk drive with at least 10 MB of free space, and EGA, VGA, or 8514/A graphics.

Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
Inquiry 989.



Get One Of These Blockbuster Movie Hits FREE When You Buy A Video Seven VGA Graphics Card.

What a great way to introduce you to three of the very best VGA cards: The VEGA VGA for personal and business applications; the VGA 1024i for advanced business applications; and the V-RAM VGA for CAD/CAM and graphics applications. All three give you razor sharp resolution and guaranteed software compatibility, plus Video Seven's 7-year warranty and exclusive support package. Buy any of them between March 1st and May 15th and we'll send you one of these all-time favorite movie videos, free.

HERE'S A HAREBRAINED IDEA FROM VIDEO SEVEN.

Just fill out the coupon and send it along with your receipt and the completed product registration card to: Seven Videos From Video Seven, P.O. Box 24527, San Francisco, CA 94124. For information: Inside CA 800-962-5700; outside CA 800-238-0101; Canada 800-548-0624.

Circle 296 on Reader Service Card

Send me my free movie video. Here's my receipt and completed registration card from my new VEGA VGA, VGA 1024i or V-RAM VGA card. Please send me:

TITLE__________

VHS__________ Beta__________

Name__________

Address (no P.O. boxes, please)__________

City______ State______ Zip______

Dealer name and address__________

City______ State______ Zip______

Date of purchase__________ B-4/90

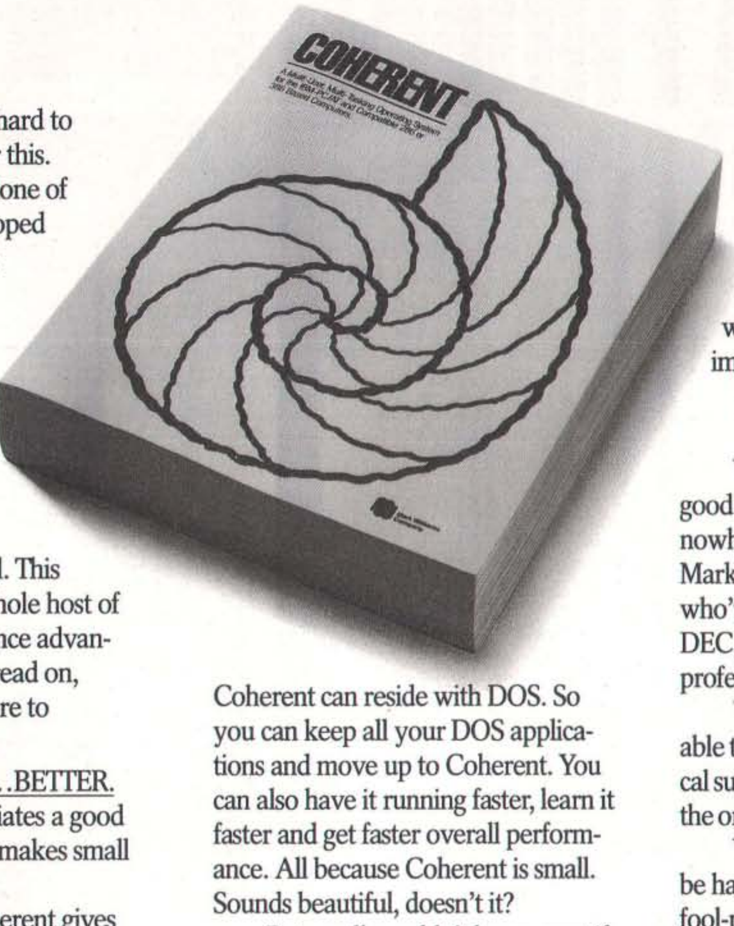
All coupons must be received by May 31, 1990. Offer expires June 1, 1990. Allow 4 to 6 weeks for delivery. Product must be purchased between March 1 and May 15, 1990.

VIDEO SEVEN

Best of Seven

A Headland Technology Inc. brand

Everything You Ever Wanted In UNIX. And Less. $99.95*



OK. We know it's hard to believe. So just consider this. Coherent™ is a virtual clone of UNIX. But it was developed independently by Mark Williams Company. Which means we don't pay hundreds of dollars per copy in licensing fees.

What's more, Coherent embodies the original tenet of UNIX: small is beautiful. This simple fact leads to a whole host of both cost and performance advantages for Coherent. So read on, because there's a lot more to Coherent than its price.

SMALLER, FASTER...BETTER.

Everybody appreciates a good deal. But what is it that makes small so great?

For one thing, Coherent gives you UNIX capabilities on a machine you can actually afford. Requiring only 10 megabytes of disk space, Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. You can also have it running faster, learn it faster and get faster overall performance. All because Coherent is small. Sounds beautiful, doesn't it?

But small wouldn't be so great if it didn't do the job it was meant to do.

EVERYTHING UNIX WAS MEANT TO DO.

Like the original UNIX, Coherent is a powerful multi-user, multi-tasking development system. With a complete UNIX-compatible kernel which makes a vast world of UNIX software available including over a gigabyte of public domain software.

Coherent also comes with Lex and Yacc, a complete C compiler and a full set of nearly 200 UNIX commands including text processing, program development, administrative and maintenance commands.

And with UUCP, the UNIX to UNIX Communication Program that connects you to a world-wide network of free software, news and millions of users. All for the cost of a phone call.

We could go on, but stop we must to get in a few more very important points.

EXPERIENCE, SUPPORT AND GUARANTEES.

Wondering how something as good as Coherent could come from nowhere? Well it didn't. It came from Mark Williams Company, people who've developed C compilers for DEC, Intel, Wang and thousands of professional programmers.

We make all this experience available to users through complete technical support via telephone. And from the original system developers, too!

Yes, we know $99.95 may still be hard to believe. But we've made it fool-proof to find out for yourself. With a 60-day money-back no-hassles guarantee.

You have to be more than just a little curious about Coherent by now. So why not just do it? Pick up that phone and order today.

You'll be on your way to having everything you ever wanted in UNIX. And for a lot less than you ever expected.

LESS IS MORE!	Coherent For the IBM-PC/AT and compatible 286 or 386 based machines.	Santa Cruz Operations XENIX 286, Version 2.3.2
No. of Manuals	1	8
No. of Disks	5	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Recommended Memory	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	$99.95	$1495.00

*Byte Execl benchmark, 1000 iterations on 20 MHZ 386.

1-800-MARK WMS
(1-800-627-5967 or 1-708-689-2300)
60-DAY MONEY BACK GUARANTEE!

Mark Williams Company
601 N. Skokie Highway
Lake Bluff, IL 60044

*Special introductory price good through July 31, 1990. Coherent is a trademark of Mark Williams Company. UNIX is a trademark of AT&T. XENIX is a trademark of Microsoft.

Apple's Special fx

The code name for Apple's new Mac IIfx was "F19," which sounds like a name for a jet fighter plane or rocket. Indeed, the Mac IIfx is one "wicked fast" computer, as the machine's product manager, Frank Casanova, describes it. Powered by a 68030 CPU and a 68882 math coprocessor operating at a clock speed of 40 MHz, this new Mac leaves its predecessors in the dust.

Apple's two most recent machines in the Mac II product line, the IIcx and IIci, were compact models with only three NuBus slots. The Mac IIfx, however, is a six-slot machine like the Mac II and Mac IIx. In addition, the Mac IIfx includes a Processor Direct Slot that is similar to the slot used in the Mac SE/30, which operates independently of NuBus and therefore offers a direct and higher-performance interface for third-party peripherals such as graphics and network controllers. The 120-pin PDS is a superset of the Mac SE/30 PDS and accepts add-in cards designed for the SE/30. Use of the PDS disables one of the six NuBus slots on the logic board, so six slots remain.

Not only does the Mac IIfx have a much faster clock speed than its Mac II cohorts, it has new features specifically designed to boost performance. To help minimize main memory and disk accesses, the Mac IIfx comes with a cache memory consisting of 32K bytes of 25-nanosecond static RAM. To ease the burden of the main processor, the IIfx has a new controller for DMA to SCSI devices like the hard disk drive, and two Peripheral Interface Controllers (PICs) for controlling the floppy disk drives, the Apple Desktop Bus, and the system's two serial ports.

Each PIC controller consists of a 10-MHz 6502 processor surface-mounted to the logic board. You might recall that the 6502 is the CPU of the Apple IIe. In this new machine, two of those IIe processors are used as peripheral controllers. The

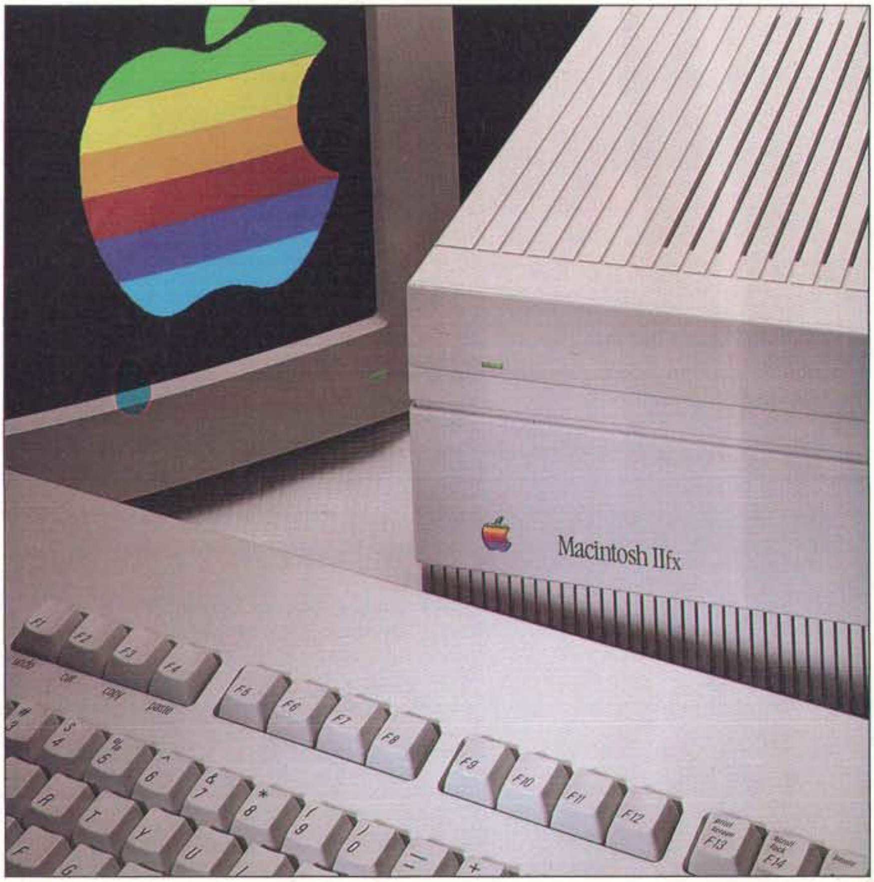


photo on page 112 shows the new logic board of the IIfx.

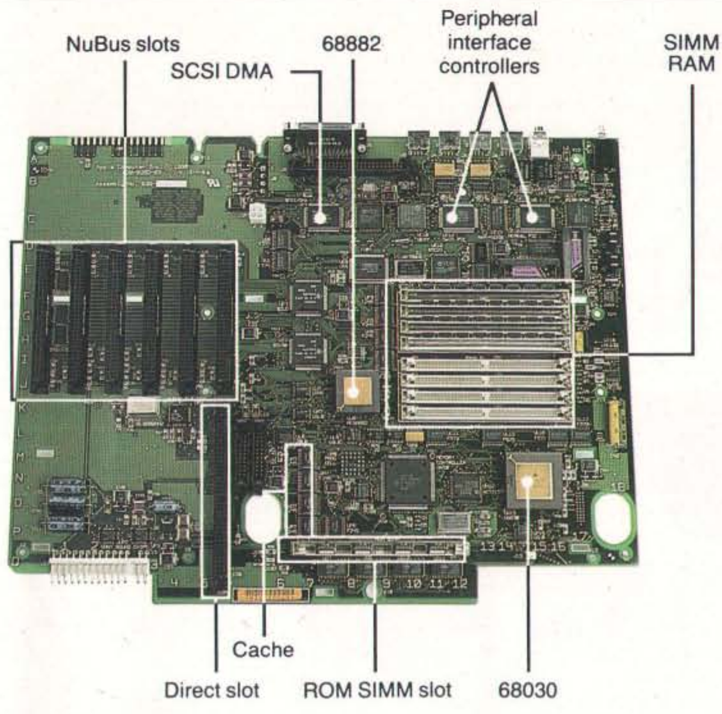
The purpose of the SCSI DMA and PIC controllers is to take over tasks that previously were performed by the central processor. Coupled with these I/O and SCSI controllers, the increased clock speed and cache memory of the machine result in a dramatic improvement in system performance, with faster disk access and processing during serial and floppy disk drive operations. Based on some benchmarks that I ran on a preproduction machine, the Mac IIfx is two to four

continued

The 40-MHz IIfx sets new Macintosh speed records

Nick Baran

PHOTOGRAPHY: LUIS DELGADO © 1990



The Mac IIfx's logic board represents a new design. Although it has new functions such as cache memory and peripheral controllers, the IIfx board has the same chip count as the IIci logic board. Note the empty real estate on the board, suggesting that a compact model with fewer slots could also be produced.

PRELIMINARY BYTE BENCHMARK RESULTS

Preliminary benchmark results reveal the speed advantage offered by Apple's new Mac IIfx.

Low-level test	Mac IIx	Mac IIcx	Mac IIci	Mac IIfx
CPU				
Matrix	17.1	16.2	10.4	6.4
String move				
Byte-wide	82.1	81.7	51.3	31.9
Word-wide	42.1	42.1	26.5	16.1
Doubleword-wide	22.8	22.9	14.2	8.2
Sieve	31.3	31.4	19.6	12.1
FPU				
Math	151.5	149.9	93.2	45.0
Sine(*x*)	72.7	73.9	45.2	21.6
e^x	96.6	98.7	60.8	29.1
Disk I/O				
Sub-Finder seek				
1-sector read	13.9	14.2	14.7	14.3
32-sector read	35.6	27.1	25.4	24.7
Video				
Text				
TextEdit	4.7	4.6	3.3	2.5
DrawString	1.6	1.6	1.1	1.2
Graphics				
Slow test	52.8	52.5	18.5	9.9
QuickDraw	0.3	0.3	0.2	0.1

times faster than the Mac SE/30 or Mac IIx, depending on the operation. On the average, the Mac IIfx is about 60 percent faster than the Mac IIci (see the table). With the SCSI DMA controller, disk seeks of 32 blocks are about seven times faster on the Mac IIfx than on the Mac SE/30. In a briefing at Apple, the IIfx executed a complicated spreadsheet and graphics routine, involving recalc and cut-and-paste operations and scrolling graphics, almost twice as fast as the Mac IIcx did.

Along with its new superfast Macintosh, Apple announced a new version of its flavor of Unix, A/UX 2.0 (see the text box "A/UX 2.0: Unix with Mac Interface Not Ready Yet" on page 113), and a new series of 24-bit color graphics boards (see the text box "24-bit Graphics with a Bang" on page 114). Clearly, Apple planned these announcements together with the rollout of the Mac IIfx to position the machine as its main platform for the high-end engineering and CAD workstation markets, where the two key components are Unix and high-speed graphics.

The Mac IIfx comes with either 4 or 8 megabytes of RAM. However, these are nonstandard 80-ns, 1-megabit single inline memory modules. Rather than standard off-the-shelf 32-pin SIMMs, the Mac IIfx uses 64-pin-wide SIMMs, which are designed to support a memory-access technique called *latched read/write*. Basically, the phrase means that read and write accesses to memory can overlap, with a "holding area" in the form of 64-bit words for managing the overlapping read/write operations. According to Casanova, Apple is patenting its latched read/write technique. While the technique was designed to improve performance, the drawback is that users who wish to upgrade their systems will have to buy these 64-pin SIMMs from Apple at Apple's premium prices. Perhaps worse, current Mac IIx or IIci users will not be able to reuse their memory if they decide to upgrade their machines to the IIfx logic board. But that's the price of high performance, I guess. It should also be noted that Apple will eventually offer 4- and 16-Mb SIMMs, allowing memory expansion of up to 16 and 32 MB, respectively.

While the logic board has been completely redesigned (it has the same chip count as the Mac IIci in spite of new cache chips, the I/O and DMA processors, and some new custom application-specific ICs), the IIfx looks just like the Mac IIx or the Mac II, and many of its

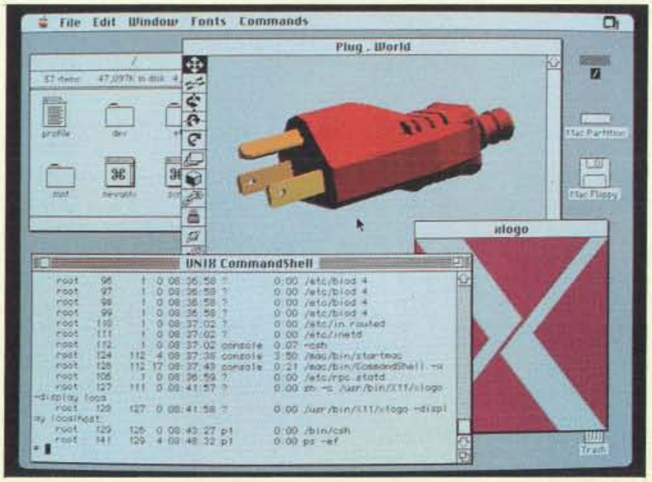
continued

A/UX 2.0:

Unix with Mac Interface Not Ready Yet

Although Unix is one of the oldest of the operating systems in use today, there is little doubt as we enter the 1990s that it is the operating system of choice for scientific and engineering applications. Any computer manufacturer who wants to compete in the federal and technical markets has to offer a version of Unix—one that has a good graphical interface.

Apple sees an opportunity to make major inroads into the Unix market by offering a version of Unix that looks to the user just like the Macintosh interface, which is probably still the premier graphical interface on the market today. Except for the NeXT computer's NextStep interface, no full-fledged, Unix-based graphical interface exists that is completely integrated with the operating system like the Macintosh interface. The Open Software Foundation's Motif and Sun's Open Look are the other major Unix graphical interface contenders, but neither of them is a complete end-user interface at this point. They are still developers' tools that will lead to end-user interfaces in the next year or two.



A/UX 2.0, as demonstrated at an Apple press briefing. Note the familiar Mac interface controlling Unix, and the simultaneous display of both Unix and Macintosh applications on the screen.

In conjunction with the introduction of the Mac IIfx, Apple has introduced A/UX 2.0, which is indeed a version of Unix (System V release 2 with BSD 4.3 extensions) with the Mac desktop interface. As you can see from the photo, A/UX 2.0 lets you run Unix and Macintosh applications simultaneously and exchange data between them from the Clipboard. You can configure the hard disk drive with two partitions—one for Unix and one for the Macintosh System—and applications are transparently accessed from either partition. Note, however, that multiple tasks under MultiFinder will not run reliably in conjunction with A/UX. According to Apple's product managers for A/UX, the Unix preemptive scheduler can "bring down MultiFinder."

You use the Macintosh Chooser to select printers and file servers. A dialog box called the Commando provides a point-and-click interface for issuing Unix commands, which are automatically routed to the Unix console window. The Apple menu is used to hide running applications that you can recall with a simple mouse-click. In addition, A/UX comes with a mouse-driven text editor and support for TCP/IP networking protocols and the X Window System. Using the Macintosh Toolbox, programmers can develop "hybrid applications" that run under Unix but take advantage of Macintosh desktop features. It's all very elegant.

Nonetheless, A/UX 2.0 isn't ready. According to A/UX product managers, it won't be ready until mid-1990. The version that was demonstrated at the press briefing looked like early alpha software, and it crashed repeatedly. Although Apple demonstrated A/UX 2.0 on a 4-megabyte Mac, it was clear that you need 8 MB of memory to run any significant applications simultaneously.

There are other concerns. While it is undoubtedly an elegant interface that lets you execute Unix and Macintosh applications simultaneously, A/UX 2.0 needs third-party applications. Some off-the-shelf Unix character-based applications may run under A/UX, but Apple supports only the QuickDraw screen-imaging model. Although the X Window System is supported in A/UX 2.0 and can run in a separate window, Unix software developers will still have to port graphics-based applications to run under QuickDraw. At this time, Apple does not support any three-dimensional graphics standards, such as PHIGS, GKS, or RenderMan. As a result, third-party developers can't write three-dimensional applications for A/UX using those standards.

On the other hand, the major appeal of A/UX 2.0 is that you can run both Unix and all the third-party Mac-based applications at the same time. An obvious use of A/UX 2.0 would be for a Unix network such as NFS (Network File System) with simultaneous access to Macintosh software, or for the development of vertical-market Unix-based applications with links to standard Mac software.

Another question is price. At the time of this writing, Apple declined to disclose its price for A/UX 2.0; but A/UX 1.0 costs about $400, and Product Manager Carol Clettenberg stated, "We have lots of additional value in this." That implies that it will cost substantially more than $400. And the price of the software is only the beginning. A/UX takes up most of an 80-MB hard disk drive. That means that you need at least an additional 80-MB hard disk drive or, preferably, an even larger hard disk drive, to store your applications and data. Add to that the cost of a fully configured 68030-based Mac II with high-resolution graphics and 8 MB of RAM, and you're looking at a very expensive system, probably in the neighborhood of $15,000 or more.

Although it's expensive when you add it all up, A/UX 2.0 looks very impressive. Now, the question is whether Apple can deliver a working product and whether software developers will write applications for A/UX 2.0

components are the same. The Apple-Talk speed is still 230 kilobits per second. The Apple sound chip is still the same 8-bit 44.1-kHz chip. And the system has the same floppy and hard disk drive options as the other Mac II models.

One improvement worth mentioning is a larger, but much quieter, cooling fan (whose diameter is 92 millimeters instead of 80 mm), which has a variable speed controller, allowing the fan to adjust speeds according to the cooling load required by the system. You can barely hear the fan with two NuBus boards installed in the machine, according to Casanova. (This was hard to tell in the briefing room, which had seven or eight machines running, along with video projectors.)

The new 512K-byte ROM SIMMs in the Mac IIfx are a superset of the ROM used in the IIci. The new ROM has hooks for System 7.0, says Casanova, and it requires a new version of the operating system (System 6.0.5) to handle the new I/O controllers.

At the time of this writing, Apple had not established a price for the Mac IIfx. Needless to say, it won't be cheap. The Mac IIfx will be offered in 4- and 8-MB configurations with only one SuperDrive floppy disk drive or with 80- or 160-MB hard disk drives. Casanova says a base system would start at between $10,000 and $12,000. In addition, Apple will be offering logic board upgrades to current Mac II and IIx users. As mentioned earlier, the upgrade will be costly because you won't be able to use the same memory modules as the earlier Mac II/IIx models use. Apple did not disclose prices for the logic board upgrade.

The Mac IIfx is built for speed, pure and simple. It looks like the machine of choice to run advanced graphics, network-server, and A/UX applications. It's the latest top-of-the-line product in an increasingly crowded Mac II product line. We now have the IIfx, the IIci, the IIcx, the IIx, and the good old Mac II. But if you're looking for the fastest Macintosh on the market, the IIfx is the one. ■

COMPANY INFORMATION

Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 1090.

Nick Baran is BYTE's West Coast bureau chief. You can contact him on BIX as "nickbaran."

24-bit Graphics with a Bang

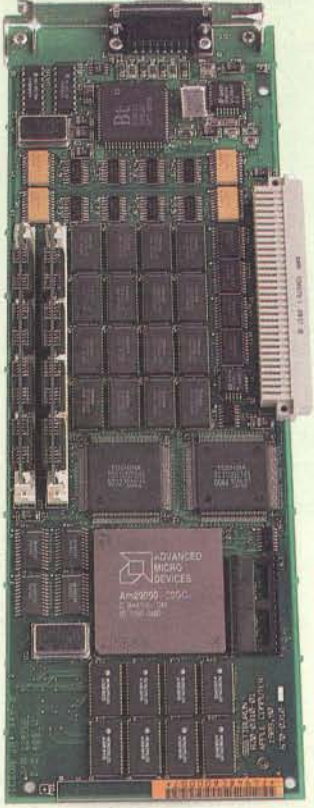
If you're going after the workstation markets, you need Unix and high-speed graphics. A/UX 2.0 is one side of the equation. The other side is Apple's new 24-bit graphics accelerator board (see the photo). Called the Macintosh Display Card 8/24 GC, the board is powered by an AMD29000 RISC processor running at 30 MHz. The accelerated version is part of a new family of color cards based on Apple's new "custom color chip," which is a single-chip replacement of the series of digital-to-analog converter chips that were used in previous Apple color boards. The board requires one NuBus slot, 2 megabytes of main memory, and version 6.0.5 of the Mac OS.

The 8/24 GC board comes with 2 MB of video memory and can be expanded to 4 MB of RAM. In color mode, the board can display images with 8 or 24 bits per pixel and has a screen resolution of 640 by 480 pixels. In gray-scale mode, the board supports 1, 2, 4, or 8 bits per pixel at a resolution of 1152 by 870 pixels. The board supports a refresh rate of 66.7 to 75 Hz depending on the resolution of the display. It also supports the RS-170 timing standard for interlaced video devices such as TVs and VCRs. However, the 8/24 GC does not have a video input port. The board automatically configures its display mode and resolution according to the display to which it is connected.

With the AMD 29000 processor, which is rated at about 20 million instructions per second at the 30-MHz clock speed, the 8/24 GC provides excellent performance for complex and colorful graphics applications. In a demonstration at an Apple press briefing, the board offered blazing speed for everything from text scrolling to movement and refreshing of 24-bit images on the screen. Apple claims that the 8/24 GC accelerates color display from five to 30 times the normal speed of color applications. The company declined to give a definite price for the 8/24 GC but said that it would cost approximately $2100.

In addition to the 8/24 GC, Apple announced less powerful color boards called the Display Card 4/8 and the Display Card 8/24. The 4/8 version is an 8-bit color board that you can upgrade to a 24-bit 8/24 card by adding video memory to it. These cards have essentially the same features as the 8/24 GC but without the accelerator board. The boards will be priced at about $700 and $1000 for the 8-bit and 24-bit versions, respectively.

The 8/24 GC is an impressive top-of-the line graphics board; the other new entries are more conventional color cards, although they support 24-bit color. However, Apple faces stiff competition from such third-party graphics board suppliers as Radius, RasterOps, and SuperMac, all of which offer 24-bit color graphics accelerators at very competitive prices.



The 8/24 GC graphics accelerator board. Note the AMD29000 RISC processor, which operates at 30 MHz. The board comes standard with 2 MB of video RAM and includes a 64K-byte static RAM instruction cache.

HP makes it a


ASTRONOMY IS LOOKING UP

THE HIRSCH REPORT OF THE SKIES — VOL. 8, NO. 4, FALL 1990

STAR SHORTS

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make meteor-burst communication a practical and economical alternative to the use of tele- *(continued on page 2)*

You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo- *(continued on page 3)*

More on planetary explosions inside.

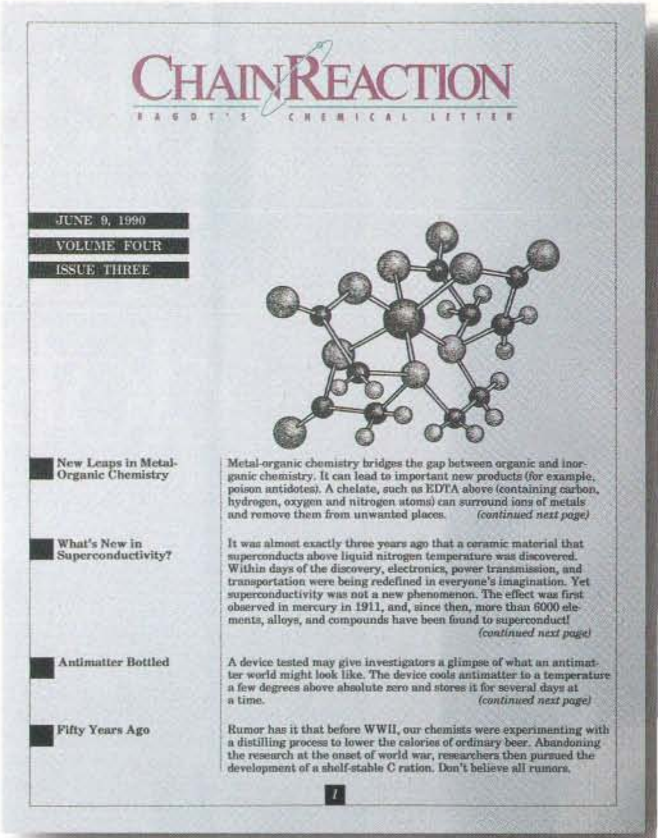
Voyager's Last Picture Show: When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.

NO BLACK HOLES?

Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that *(continued on page 3)*

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele- *(continued on page 5)*


CHAIN REACTION

BAGOT'S CHEMICAL LETTER

JUNE 9, 1990

VOLUME FOUR

ISSUE THREE

New Leaps in Metal-Organic Chemistry

Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA above (containing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. *(continued next page)*

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! *(continued next page)*

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. *(continued next page)*

Fifty Years Ago

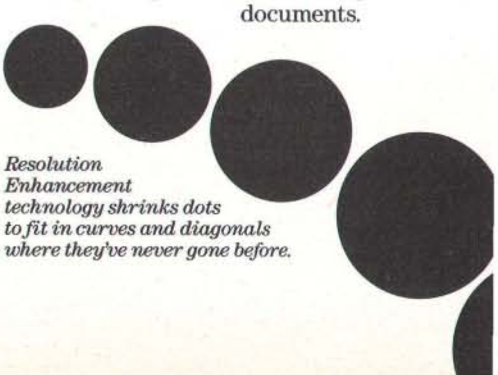
Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf-stable C ration. Don't believe all rumors.

1

Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

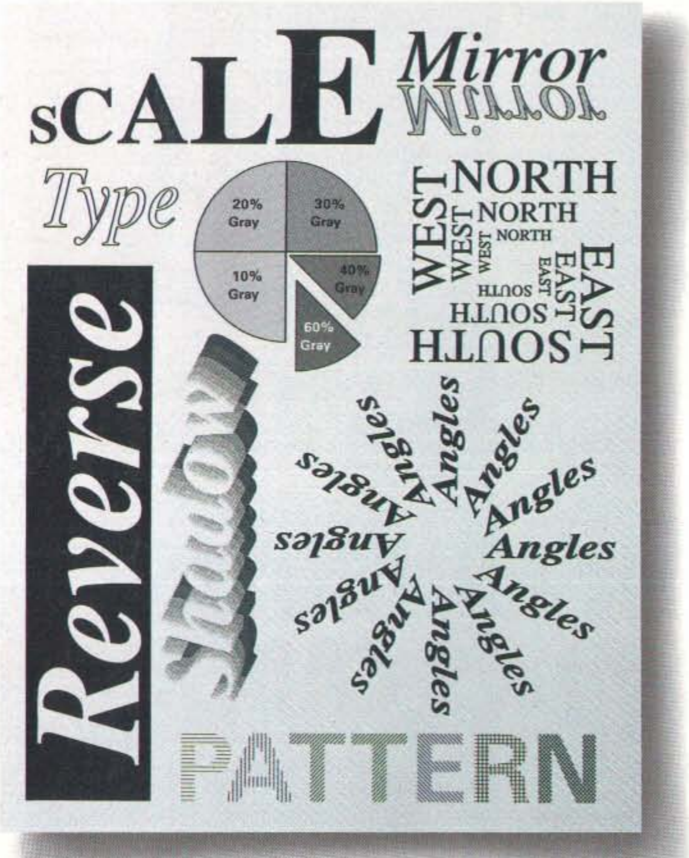
The rules have changed. Now the name of the game is Resolution Enhancement technology. You'll call it the best thing to happen to laser printing since the very first HP LaserJet printer. It gives you clearer resolution. Curves that really curve. And edges that are never jagged.

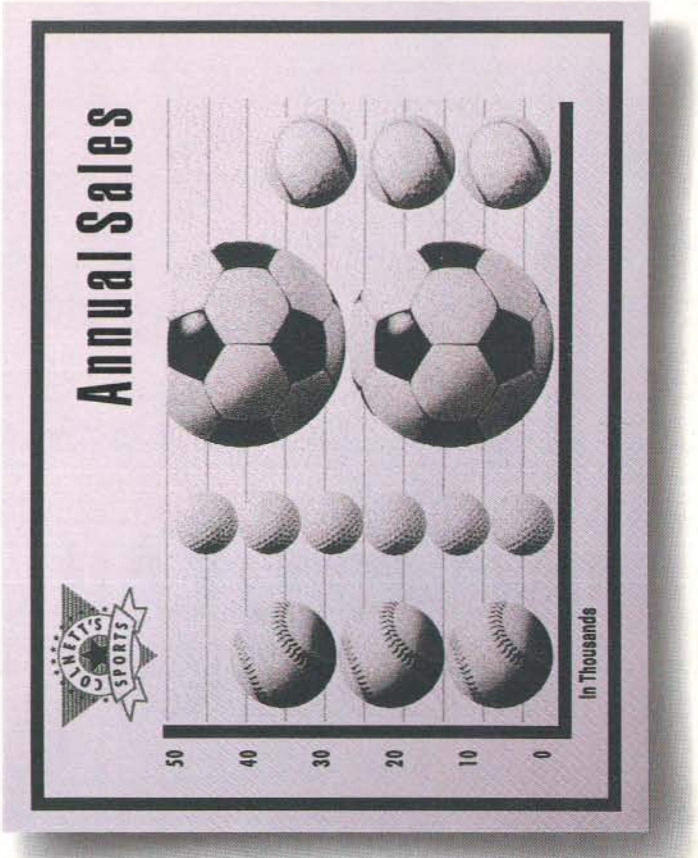
Instead of a "one-size-fits-all" dot, HP's built-in intelligence varies dot sizes. So they can fill areas where they could never go before. For clearer, more professional-looking documents.



Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

whole new ball game.





But there's more than better print quality. 14 bit-mapped fonts and 8 internal scalable typefaces provide thousands of options. And enhancements to our PCL5 printer language, including our HP-GL/2 graphics language, let you print portrait and landscape on the same page. Reverse and angled type. Spirals. Even shaded text. You can also plug in Adobe PostScript® software.

For all its new features, the $2,395* list price of the HP LaserJet III is a good deal less than the HP LaserJet

Series II printer it replaces. With the same hardware compatibility, wide range of applications, 8 ppm print speed, and software compatibility, including WordPerfect 5.1 and WordStar® 5.5. And the same reliability as the rest of the HP printer family.

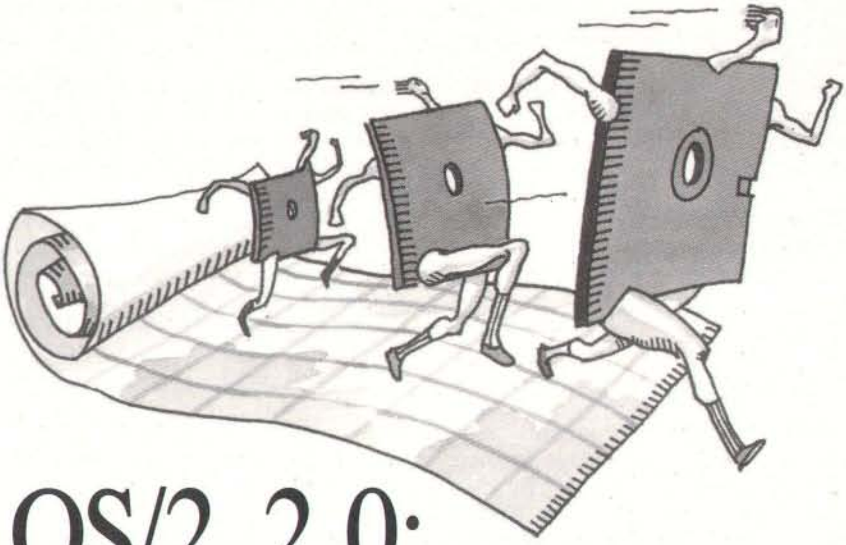
So call **1-800-752-0900, Ext. 1007.** Ask for our booklet on Resolution Enhancement technology and where to find your nearest authorized HP dealer. We'll put you in a whole new league.

There is a better way.

HEWLETT PACKARD

Circle 135 on Reader Service Card

32-bit OS/2 forges ahead, with DOS and Windows in tow



OS/2 2.0: It's a Family Affair

■ Jon Udell

It's going to be a flat world after all. Microsoft's long-awaited 32-bit OS/2 2.0 joins the list of 386 operating systems—Unix, NetWare 386, 386|DOS-Extender—that have abandoned segments in favor of the flat model. Of course it isn't a flat world yet. Thirty-odd million DOS systems, several million Windows systems, and a few hundred thousand OS/2 systems run segmented programs today and will continue to do so for a long time to come.

Can OS/2 2.0 inherit the features of its three 16-bit predecessors and still realize its 32-bit destiny? I don't see why not. OS/2 2.0 runs 1.x binaries and offers both 16- and 32-bit application programming interfaces (APIs). More important, it features DOS support that far outperforms the 1.x compatibility box. OS/2 2.0 can multitask DOS and even Windows sessions, each in an OS/2 screen group or Presentation Manager (PM) window and scheduled as a normal OS/2 process.

The Unix-style memory model and DOS multitasking add up to a "hit 'em high, hit 'em low" strategy. At the high end, OS/2 can now compete strongly as a server platform. LAN Manager 2.0's HPFS-386 (High Performance File System) is a crucial ingredient, but OS/2 2.0's ability to run 32-bit applications on the server with paged virtual memory completes the picture. Microsoft can't realistically expect to dominate the server market. Today, nearly half of the server-class machines that cost between $15,000 and $350,000 run Unix; the other half run IBM, DEC, or other proprietary operating systems; less than 1 percent run OS/2. Still, an OS/2 freed from its 16-bit shackles should be able to carve out a significantly bigger piece of the midrange pie.

Farewell to Segments

In view of that goal, Microsoft's choice of the flat memory model is a strategic decision, not merely a technical one. Segments, per se, aren't evil. What gave them a bad name was that, on the 286 with its 16-bit registers, segments were too small—just 64K bytes. On the 386, with 32-bit registers, a segment can span 4 gigabytes. An operating system can organize kernel and process-address spaces as one or several of those segments. That choice determines whether segment-oriented or just page-oriented mechanisms can protect the kernel from user processes, and processes from one another.

Experts differ on what's best, but segments have advantages, notably limit-checking, that OS/2 2.0 forgoes. Why toss them completely? Technically, they're inconvenient. Even with fewer, larger segments, there's inefficiency associated with loading selectors. Programmers are just plain tired of them, but strategically, they're a disaster. Competitive Intel-based operating systems don't use the segmentation hardware, and most other 32-bit processors don't even have segments. Although the flat model won't make OS/2 applications portable to other operating systems and processors, at least it will make them less nonportable. It makes reverse migration feasible as well. The prophesied union of OS/2 and the FORTRAN/COBOL code base may yet come to pass.

Battle for the Desktop

At the low end, it's a different story. Here, OS/2 contends for desktop supremacy in a market that Microsoft already dominates. Although the Macintosh finds wide favor, and the romance between Unix and 386 PCs continues to heat up, these systems, like OS/2 itself, compete mainly with DOS and Windows. To judge OS/2 a failure because users still cling to DOS, or because there aren't more OS/2 applications, begs the question. The DOS desktop market is huge; its inevitable upward migration will be glacially slow. As users do move, they'll have to make a choice. OS/2 2.0's competitive 32-bit capabilities and strong DOS support will make it a likely candidate. Microsoft wins to the extent that users will choose OS/2.

The imminent Windows 3.0, which Microsoft acknowledges will run Windows applications in protected mode and so give them access to large memory, clearly complicates matters. Those who have used OS/2 know that memory management is just one of its advantages over Windows. Windows rests on a shaky foundation, namely DOS, and it won't ever match the multitasking, multithreaded capabilities of OS/2. Nevertheless, users who don't yet see OS/2's superiority will, in the short term, almost

continued

ILLUSTRATION: ROBIN JAREAUX © 1990

certainly make Windows 3.0 a successful applications platform. More trouble for OS/2? Again, only if users, when they migrate, don't choose it.

OS/2 and Windows: An Applications Strategy

Although OS/2 2.0 won't run Windows binaries, its ability to run Windows in a DOS session will help keep users in the family. Even more helpful would be a way to simplify porting Windows applications to PM. Despite their conceptual similarity, the two programming environments differ radically in their implementation. Today, a port from Windows to PM can be a painful exercise. Microsoft is therefore at work on a "mapping layer," analogous but unrelated to Micrografx's Mirrors, designed to ease the Windows-to-PM transition. Microsoft hopes to add the still-unnamed tool to a future release of the 2.0 Software Development Kit (SDK). It's not version-specific, though; Microsoft expects it to work for current and future versions of Windows and OS/2.

Developers will, in theory, be able to port Windows applications in gradual stages. Minimally, they'll have to touch perhaps 10 percent of their code in order to meet the requirements of the mapping layer's interface. Mainly, that means converting interrupts to system calls. The emulator would then enable OS/2 to run the Windows application, with an estimated 5 percent to 10 percent performance penalty. The Windows program could even exploit features of the kernel—threads, interprocess communication, scalable fonts, and HPFS. Ultimately, of course, a full PM port is best, but the emulator should lower the threshold of resistance and help OS/2 capture the still-burgeoning Windows applications market.

The 2.0 SDK

Microsoft announced shipment of the 2.0 SDK on the last day of last year and began filling orders in quantity about six weeks later. It's the usual deal. This time, developers will have to pony up $2600 to get the series of releases leading up to the final 2.0. What are they paying for? In Microsoft's view, tools, on-line support, and a head start on building 32-bit applications. In the eyes of some developers who have already invested thousands of dollars in previous OS/2 SDKs, the opportunity to alpha-test yet another new operating system. Obviously, the big players won't blink. To what extent this policy alienates the "little guy," and so impedes the flow of OS/2's lifeblood applications, we may never know. In any event, when a final version of 2.0 ships sometime this year, everyone can join the party—for the price of a compiler upgrade and an OS/2 toolkit.

The SDK version of the operating system, fat with debugging instrumentation, wants 6 megabytes of RAM. Microsoft expects the final version to run in 4 MB, and, given that 2.0's more efficient paged virtual memory system will make more of the kernel swappable, that seems attainable. In its current incarnation, the system looks and feels just like OS/2 1.2. The SDK includes 32-bit versions of Microsoft C and MASM (Microsoft Macro Assembler). The C compiler, called Microsoft C 5.2, isn't the new 6.0 compiler that was in beta test at the time of this writing, but rather a 32-bit adaptation of Microsoft C 5.1. However, the SDK does include a prerelease version of CodeView 3.0, the debugger that's bundled with Microsoft C 6.0. Eventually, 6.0 and its Programmer's Workbench should work with OS/2 2.0, but Microsoft hasn't yet committed to a release date.

In other respects, the SDK is a typical OS/2 toolkit. It includes the resource and help compilers; icon, dialog box, and font editors; and sample code. Like the 1.2 toolkit, which began shipping around the time of the 2.0 announcement, it will also include the Dialog Manager, which supports COBOL- and FORTRAN-generated screens in the PM environment, and IBM's CUA (Common User Access) style guide. These components testify to OS/2's key role in IBM's plan to integrate applications across platforms, which is known as SAA (Systems Application Architecture).

The New Memory Model

OS/2 2.0 accomplishes the shift to a 32-bit programming model gracefully. Developers familiar with version 1.x needn't worry about API shock. The vast majority of kernel and PM function calls don't change. Dual 16- and 32-bit support takes the form of 16- and 32-bit dynamic link libraries (DLLs) and header files that control parallel name spaces. You will still write `DosOpen` and `DosCreateThread`; when compiling for 32-bit mode, those names will become `Dos32Open` and `Dos32CreateThread`. Those functions that manipulate segment selectors, such as `DosAllocSeg` and `DosAllocHuge`, are gone. But few programmers will shed many tears for them.

> **O**S/2 *threads, or "lightweight processes," offer huge advantages to the applications that use them; they also support multitasking.*

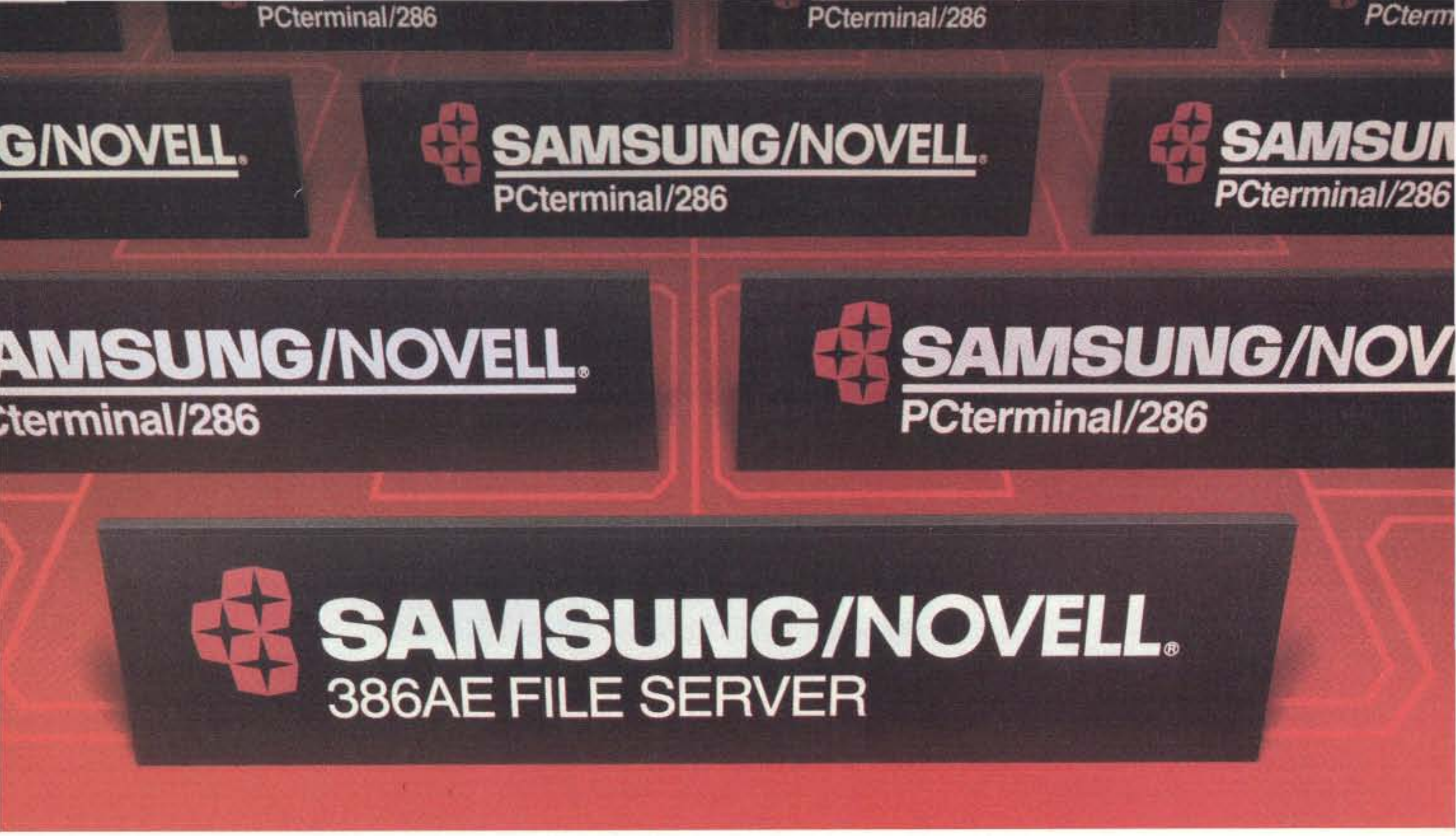
The new unit of memory allocation is called a "memory object" and is simply a contiguous set of 4K-byte pages in the linear address space. Flags to the allocation routines specify access permissions: read, write, execute, or guard. Guard pages facilitate the use of "sparse memory objects." OS/2 2.0 distinguishes between *allocating* and *committing* memory. To allocate memory means to reserve linear address space; to commit it means to map physical pages into that reserved space and possibly trigger page swapping. Guard pages enable the system (or the programmer) to commit memory dynamically to an allocated region; stacks are the most obvious use for the technique. When there's a reference to a guard page, the processor generates a guard-page fault; a system- or user-defined exception handler can then commit a physical page and make the next page a guard page.

Since there's no way to defragment the linear address space or reallocate memory, sparse memory lets programmers allocate ridiculously large chunks—limited only by the backing store—without involving the virtual memory subsystem until it is actually needed.

Threads, Semaphores, and Other Enhancements

OS/2 threads, or "lightweight processes," offer huge advantages to the applications that use them. Threads support multitasking not only between, but within, applications. Unfortunately, in version 1.x, threads proved notoriously tricky to use. Programmers had to allocate stack memory for threads. Because threads share process memory, programmers relied heavily on semaphores to coordinate access to that shared memory, and these were in short supply. Semaphore semantics were confusing, and the behavior of semaphores was unreliable in some cases. However, OS/2 2.0 should help to improve matters.

continued



How to plan your LAN.

You'll need a pencil.

That's to write down the telephone number on the bottom of this page. Which will connect you with Samsung's nationwide network of resellers. And the Samsung/Novell co-labeled line of LAN hardware.

With one call you can plan on substantial savings over the big name computers which, despite high clock rates and even higher price tags, are not really optimized for networking.

And you can plan on 100 percent compatibility with all versions of Novell's NetWare®, because Samsung's LAN hardware was co-designed by Novell.

THE TESTING WENT IN BEFORE THE LABEL WENT ON.

Samsung's 386AE and PCterminal/286 have been tested exhaustively and certified by Novell for compatibility with all popular networking products. In fact, Samsung's 386AE is one of 3 fileservers certified by Novell to run NetWare 386.

Novell's engineers successfully tested the PCterminal/286 in 1200 network configurations...with 50 units running at once! No other computer manufacturer can make that claim.

NETWORKING VS. NOTWORKING.

What's the difference? Take our 386AE Fileserver. It includes Novell's Advanced BIOS and 8 expansion slots to accommodate multiple network interface cards and disk controllers. Plus an oversize power supply for driving dual high capacity hard disks and tape backup system. Plus 4 megabytes of memory for disk caching.

Then there's Samsung's PCterminal/286 Diskless Workstation with a built-in Ethernet interface and Remote Boot EPROM.

And not to be overlooked is our 16-bit SE2100 Ethernet Interface Card which provides up to twice the throughput for the price of an 8-bit card.

CALL TODAY.
For the name of the Samsung reseller nearest you, call us today at **1-800-624-8999, ext. 851.**

WINNER OF LAN TIMES READERS CHOICE SAMSUNG/NOVELL. PCterminal/286

The 386AE and PCterminal/286. More than affordable. SAMSUNG

Circle 252 on Reader Service Card (DEALERS: 253)

The system now dynamically allocates stack memory for threads using the guard-page feature. The semaphore functions are new and are incompatible with the 1.x functions. Semaphores in 2.0 come in three flavors: event, mutual exclusion (`mutex`), and multiple wait (`muxwait`). Event semaphores provide a basic interthread signaling mechanism. The `mutex` semaphores work similarly but are designed for serializing critical sections of code in multiple threads. The `muxwait` semaphores permit a thread to wait on multiple semaphores, all of which must be of either the event or `mutex` variety. All semaphores are now handle-based and reside outside an application's address space.

Other enhancements include built-in floating-point emulation (a DLL that's not loaded on an i486 or if an 80387 is present), improved exception-handling capabilities that language extensions can make available to users, new device helpers (`DevHlps`) to enable device drivers to communicate with the linear address space, and a general relaxation of system limits. OS/2 2.0 supports more threads (4000, versus 1.2's 512 and 1.1's 256), and vastly more semaphores—64,000 per process.

There's one major omission. OS/2 2.0 does not support the VIO/KBD/MOU packages, which bypassed PM to give 1.x developers direct control of the keyboard, screen, and mouse. So there's no middle ground anymore. It's either PM or `printf` (primitive teletype-style I/O).

MVDM: Multiple Virtual DOS Machines

There's no shortage of 386 DOS multitaskers these days. DESQview, VM|386, and VP/ix are notable examples of programs that use the V86 mode of the 386 to good effect. But OS/2's MVDM facility exploits an advantage that is uniquely Microsoft's. Other DOS multitaskers run off-the-shelf MS-DOS. MVDM's designers grabbed the DOS 4.0 source code, threw away the file system and other nonessentials, and ended up with an OS/2 2.0–specific version of DOS that leaves more than 620K bytes of RAM free for real-mode applications.

It's eerie to see DOS programs like Lotus 1-2-3, WordPerfect, and even Flight Simulator running in overlapped PM windows, side by side with PM applications. A DOS program can run in the background as an icon. DOS programs can even use the PM clipboard. For example, you can cut a block of numbers out of 1-2-3 using PM's mouse and paste the numbers into WordPerfect or the PM version of Excel. MVDM will allow a full-screen DOS program to write straight to the display. And it supports EMS memory. Tunable parameters, such as task priority and idle detection, aren't in the first SDK version of OS/2 but will be made available.

MVDM comes with "virtual device drivers" for the standard character devices: video, keyboard, printer, and communications port. There won't be VDDs for block devices (at least initially), so DOS programs won't be able to talk directly to network adapters, CD-ROM readers, tape drives, and the like. You'll have to depend on OS/2's support for such devices—and that's been a sore point with OS/2 thus far. There aren't many OS/2 network drivers available yet, and, despite Microsoft's commitment to CD-ROM publishing, there's no OS/2 CD-ROM driver yet.

You won't be able to run DOS-extended programs, such as the DOS versions of Lotus 1-2-3 release 3.0, AutoCAD 386, Mathematica, and IBM Interleaf Publisher, under 2.0's MVDM. OS/2 2.0 doesn't, and won't, support VCPI (Virtual Control Program Interface). Options are to use dual-boot or wait for PM versions of these programs—which, in the case of 1-2-3 and AutoCAD, have already appeared. Although Microsoft acknowledges a need for DOS programs under MVDM to use extended memory better than EMS memory allows, there's no announcement yet of a plan to accomplish that.

Royal Fonts

Although Royal fonts aren't included in the first SDK release of 2.0, Microsoft has demonstrated the technology. Apple licensed the Royal font format to Microsoft. In the near term, this means that OS/2 2.0 and the forthcoming Macintosh System 7.0 will be able to exchange and use identical, high-quality, scalable display fonts. When Royal printers appear, both operating systems will be able to operate with them as well.

> **COMPANY INFORMATION**
>
> **Microsoft Corp.**
> 16011 Northeast 36th Way
> P.O. Box 97017
> Redmond, WA 98073
> (206) 882-8080
> **Inquiry 880.**

Royal is especially well suited to OS/2's GPI (Graphics Programming Interface). OS/2 defines its own vector-font API, which need not change to accommodate Royal. OS/2 features a unified imaging model that makes virtually no distinctions between screen and printer graphics. OS/2 2.0 defines no new APIs for Royal, because it doesn't need to. From an application writer's perspective, the necessary tools are already in place.

It's (Almost) the Real Thing

OS/2 is finally growing up. Flat addressing, paged virtual memory, an extremely powerful and flexible file system, an excellent graphical user interface, DOS multitasking, and a unified imaging model: It all adds up to certain success in the long run. How long? That may not matter; Microsoft can afford to wait. So long as there isn't a mass exodus to alternate platforms—and the next couple of years admittedly will be critical—2.0 will be there to greet users who grow weary of wrestling with DOS and its extensions.

But the picture isn't completely rosy. OS/2 2.0 is still wobbly; a final release is many months away. OS/2 device driver support remains spotty—in some cases, such as printer control langauage and CD-ROM, unconscionably so. Applications are few. Development tools aren't what they should be. And the proliferation of Microsoft systems—DOS, Windows, 16-bit OS/2, and now 32-bit OS/2—fragments the finite pool of programming talent to an alarming degree. We'll see how it all plays out. But I've seen the system that I want to install on my 386 PC. It's OS/2 2.0. ■

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

Sizzling RISC Systems from IBM

■ Andy Reinhardt and Ben Smith

IBM's POWERstation 320 desktop and POWERstation 530 deskside systems. The desktop unit (left) is showing a ray tracing generated by the high-performance three-dimensional graphics board. The deskside system (right) is running OSF/Motif.

Last year saw an explosion of interest in Unix workstation computing, but IBM's position in the market remained a big question. How would the company upgrade its lackluster RT system? In December, BYTE was invited to preview the answer, the RISC System/6000 family of high-performance workstations and servers. Codeveloped by IBM's Yorktown, New York, and Austin, Texas, research labs under the code name "RIOS," these machines are IBM's new Unix flagships.

The RISC System/6000 sets a new performance standard, boasting speeds of 28 million instructions per second on the desktop and over 40 MIPS in the fastest models. Preliminary benchmarks for the entry-level system appear to show performance 2.5 times that of the Sun SPARCStation 1; the machines have enough power to emulate an Intel 8086 *in software* and still run DOS applications faster than an AT. Most important, the RISC machines are designed not just for technical users but also for multiuser commercial applications, which speaks volumes about IBM's commitment to the Unix market.

The pricing is also very aggressive. An entry-level machine sells for $12,995 and includes a 120-megabyte hard disk drive, 8 MB of RAM, a 19-inch 1280- by 1024-pixel monochrome display, an Ethernet card, a keyboard, a mouse, AIX and OSF/Motif software, and a one-year warranty. A desktop server model has a 240-MB hard disk drive and sells for $14,945.

Variations on a CPU

The product line includes nine RISC machines based around a common CPU architecture, plus an array of add-ins and a low-cost X terminal (see the table). IBM is also releasing a new version of AIX—its home-grown Unix variant—with the machines.

The new AIX 3 has a file system that can span physical devices and change in

IBM's new family of RISC-based Unix systems offers tremendous power

size while the system is being used. It also includes PC-Simulator, an IBM product that allows the RISC machines to run DOS programs.

The systems are packaged in three basic models: desktop, deskside (or tower), and rack-mount. The desktop and deskside units are available as workstations or servers, while the cabinet-size rack-mount model is a server only. Many subsystems, including memory boards, mass storage, and graphics and communications cards, are common across the product family. In this article, we will focus on the entry-level platforms.

The 32-bit superscalar CPU is constructed of seven to nine CMOS chips containing more than 6 million transistors. Its architecture, which IBM calls "second-generation RISC," includes separate fixed-point, floating-point, and instruction/branch units that operate in parallel, for a total execution rate of up to five operations per cycle. In addition, the chip set includes separate data cache, storage control, and I/O control units. Depending on the model, the CPU operates at 20, 25, or 30 MHz. (See the figure.)

The new processor can access a vast amount of memory. Full 32-bit memory addressing allows it to directly address up to 4 gigabytes of real memory, and 52-bit virtual address generation permits access to a whopping 4 petabytes (i.e., 4 million gigabytes) of virtual memory. Real memory is located on a special high-speed synchronous bus that passes data to the cache on a 64- or 128-bit-wide path, depending on the model, at speeds of between 160 and 480 megabytes per second.

All the systems include an enhanced version of IBM's Micro Channel bus that uses data streaming to allow burst-mode transfers at up to 40 MBps, twice the speed of the bus in the PS/2s. The sustained throughput is 25 to 30 MBps. The new Micro Channel also specifies a 77 percent larger card size to allow more complex designs, and it performs parity checking on all data; however, it still accepts the smaller boards engineered for PS/2s. All the new high data-rate cards available for the systems, such as graphics, SCSI, and network interfaces, have on-board I/O processors and are bus-mastering.

To boost system reliability, all members of the family include error-detection and correction capabilities unprecedented in workstations, including a suite of 80 to 100 power-on self tests, parity checking on all buses and boards, bad-bit-swapping, and memory scrubbing.

The RISC CPU is a uniprocessor and isn't designed to allow closely coupled multiprocessing like many minicomputers. However, with an eye to distributed computing, IBM has built-in support for a 20-MBps optical link that lets systems share data in clusters. This technology will be implemented in the future.

Desktop POWERhouse

The entry-level RISC systems are called the POWERstation 320 and POWERserver 320. (POWER is an acronym for performance optimization with enhanced RISC.) Both use the same polycarbonate

continued

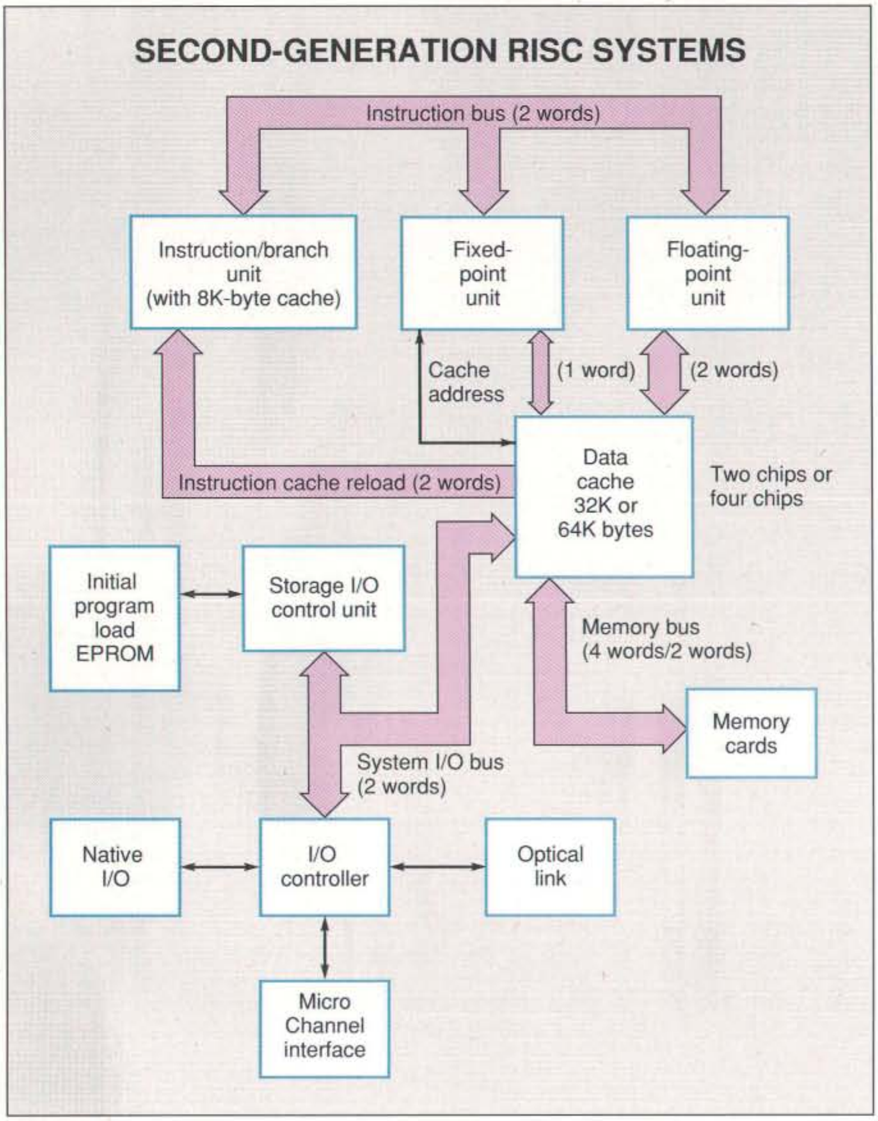
SYSTEM CONFIGURATIONS FOR THE RISC SYSTEM/6000 FAMILY

IBM's new RISC System/6000 consists of six models, all of which use essentially the same proprietary RISC CPU.

Model	Packaging	CPU/cache	Memory slots	Standard RAM	Maximum RAM (1-Mb/4-Mb SIMMs)	Micro Channel slots available	Storage bays (full-/half-height)	Standard storage[1]
320	Desktop	20 MHz/32 KB	2	8 MB	32/128 MB	4	0/2	120 MB
520	Deskside	20 MHz/32 KB	8	8 MB	128/512 MB	7	3/6	355 MB
530	Deskside	25 MHz/64 KB	8	16 MB	128/512 MB	7	3/6	355 MB
540[2]	Deskside	30 MHz/64 KB	8	64 MB	128/512 MB	7	3/6	640 MB
730[3]	Deskside	25 MHz/64 KB	8	16 MB	128/512 MB	6	3/6	355 MB
930[2]	Rack-mount	25 MHz/64 KB	8	16 MB	128/512 MB	6	4/8 per drawer	670 MB

[1]Storage, internal hard disk drives: 120-MB (desktop only), 320-MB (3½-inch); 355-MB, 670-MB, and 857-MB (5¼-inch); backup: 8-millimeter digital audio tape-recording system (internal/external), and ¼-inch and ½-inch tape (external); other: External 5¼-inch floppy disk drive and internal CD-ROM drive.
[2]POWERserver only.
[3]POWERstation only.

Notes: All systems include one 3½-inch 1.44-MB floppy disk drive and the following ports: keyboard, mouse, tablet, external floppy disk drive, parallel, and two serial. Deskside systems include one 4-MBps SCSI adapter; the 930 has two. The 730 includes a two-slot graphics card.



Block diagram of RISC CPU architecture. Note the separate units for fixed-point, floating-point, and instruction/branch operations. All memory access flows through the data-cache unit, while the storage I/O control unit and I/O "combo" chip control Micro Channel and bus access.

plastic enclosure, but the server version will sport more storage.

The desktop unit is a little larger than an IBM AT: It measures 6⅗ inches tall, 18 inches wide, and 20⅗ inches deep, and it weighs between 28 and 34 pounds. Inside the unit are a *system planar* (the motherboard [see photo 1]) and a *CPU planar* (see photo 2) that plugs into the unit perpendicularly. Both boards use an advanced eight-layer construction, with four signal and four power/ground layers; the CPU board is practically devoid of passive components.

The desktop CPU uses a seven-chip complex that operates at 20 MHz and includes two 16K-byte data-cache chips, or 32K bytes of cache. (Larger systems use a nine-chip set that has 64K bytes of data cache.) In addition to the CPU slot, the system planar has two memory slots, four Micro Channel slots, a "direct attach" hard disk drive connector, 192K bytes of self-test and boot EPROM, and an assortment of I/O ports. Rounding out the interior are a quiet cooling fan and a 265-watt, auto-sensing power supply with its own fan.

The standard memory allotment is 8 MB of 80-nanosecond RAM, configured as eight 1-MB single in-line memory modules on a single memory board. Double-sided 2-MB SIMMs are also available that would allow each memory board to hold 16 MB, for a total system memory of up to 32 MB. When 4-megabit DRAM chips become available in the future, the desktop unit will be able to hold 128 MB of real memory. For mass storage, the desktop includes two 3½-inch 120-MB hard disk drives mounted in a special carrier and plugged into the hard disk drive slot, and a 3½-inch 1.44-MB floppy disk drive.

For commercial installations, IBM provides a range of multiport asynchronous cards to connect ASCII terminals. For graphics applications, IBM offers four cards: gray-scale and color two-dimensional boards and two three-dimensional color options, which will be discussed later in the article. You can choose from 13 displays that range from a 12-inch, 640- by 480-pixel monochrome model to a 23-inch, 1280- by 1024-color unit, or you can use previously purchased displays.

The deskside systems, which look like small minicomputers, share similar packaging and internal design, but they vary in performance and configuration. In these models, the system and CPU boards are on the same plane, attached end to end (see the table for specifications).

Reestablishing the Lead in RISC

IBM invented RISC in 1975 with the 801 processor. The 801 was almost used as the heart of the IBM DisplayWriter, but, instead, it evolved into the CPU for the IBM RT, which was introduced in 1986.

The RT's anemic floating-point and graphics performance prompted IBM to design a new-generation CPU. The RIOS project had a major design objective: to achieve an execution rate of less than one cycle per instruction. Hand-in-hand were commitments to use 1-micron VLSI CMOS technology for low-power and cooling requirements, to offer large virtual memory and real-time interrupt handling, to develop optimized Unix compilers, to use industry standards, and to provide the best price/performance ratio on the market.

IBM's definition of RISC relies less on a small instruction set—there are 184 instructions, comparable to some complex-instruction-set computer architectures—than on optimizing them to execute in a single cycle or less. To achieve this, the RISC CPU uses parallelism and pipelining. At the heart of the CPU are three separate processor chips: the instruction/branch unit (ICU), the fixed-point unit (FXU), and the floating-point unit (FPU).

The ICU is responsible for doling out

instructions to the FXU and FPU and for resolving branch conditions. Instructions are pulled from an 8K-byte cache located on the same chip, which is in turn fed from memory through the data cache in 64-bit increments. The ICU can execute two operations internally while at the same time issuing orders to the FXU and FPU.

The ICU has two particularly powerful capabilities. First, it contains a special 32-bit register that is used to track the status of up to eight branch conditions. Using this register and instruction look-ahead, the ICU can *presolve* branches and execute them as soon as conditions permit. This so-called "zero-cycle" branching is more efficient than the methods that are used in other RISC architectures.

Second, the ICU contains special registers into which the complete machine state is stored in the event of an interrupt. This permits the system to vector quickly to an interrupt service routine without using a time-consuming stack operation that would involve FXU address generation and memory access.

The FXU is less remarkable in its design, but it plays an important role in generating and translating addresses and controlling the data cache. What is significant is that these tasks have been off-loaded from the usual RISC CPU. The FXU performs all integer arithmetic and logical operations and contains the segment registers for memory addressing. One unusual feature for a RISC system is that the FXU supports special string instructions for handling null-terminated strings (used in C) or length-specified strings (used in Pascal) with minimal overhead.

The key to RISC performance is that the FPU receives instructions concurrently with the FXU and executes them at the same rate. The FPU has a 64-bit path from the data cache and conforms to IEEE floating-point standards. A pipelined design lets it spit out a double-precision result every cycle with only a two-cycle latency.

The FPU also has one special instruction (multiply/add) that executes in the same time required for simple adding or multiplying. This single instruction permits the system to execute the equivalent of five operations per cycle, even though only four are dispatched at a time.

All the chips in the CPU are implemented in VLSI CMOS using 1-micron technology. The packages, roughly 1 inch on a side, have between 184 and 293 pins each and are socketed for easy replacement. For reliable cooling, each chip is topped with an aluminum heat sink. Most of the rest of the components in the system are surface-mounted.

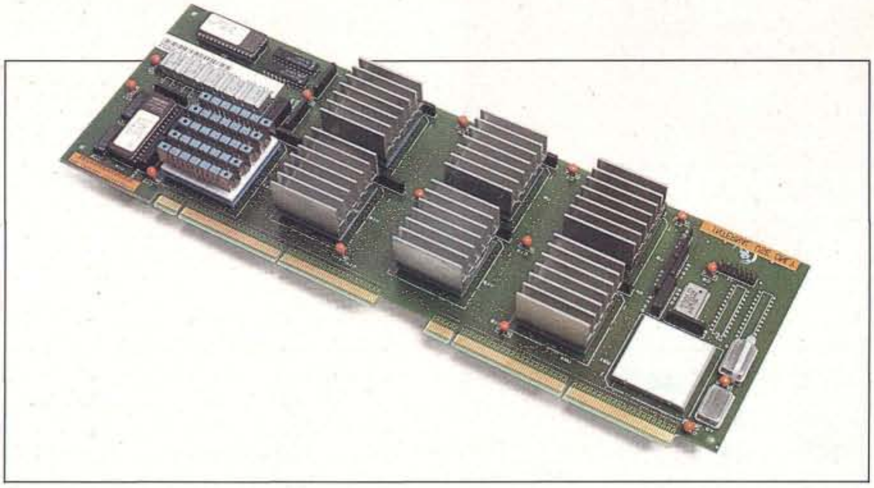


Photo 1: *The 20-MHz CPU planar for the desktop. The CPU plugs into the slot on the system planar. Note the heat sinks on top of the chips.*

Data Paths

The cache is the interface to the main memory, and it feeds instructions to the ICU and data to the FXU and FPU. Instead of off-the-shelf static RAM components, IBM uses a custom cache design that is two- or four-way associative. The company claims that this design permits a hit rate that is equal to a direct-mapped static RAM cache two times as large.

The entry-level desktop and deskside

continued

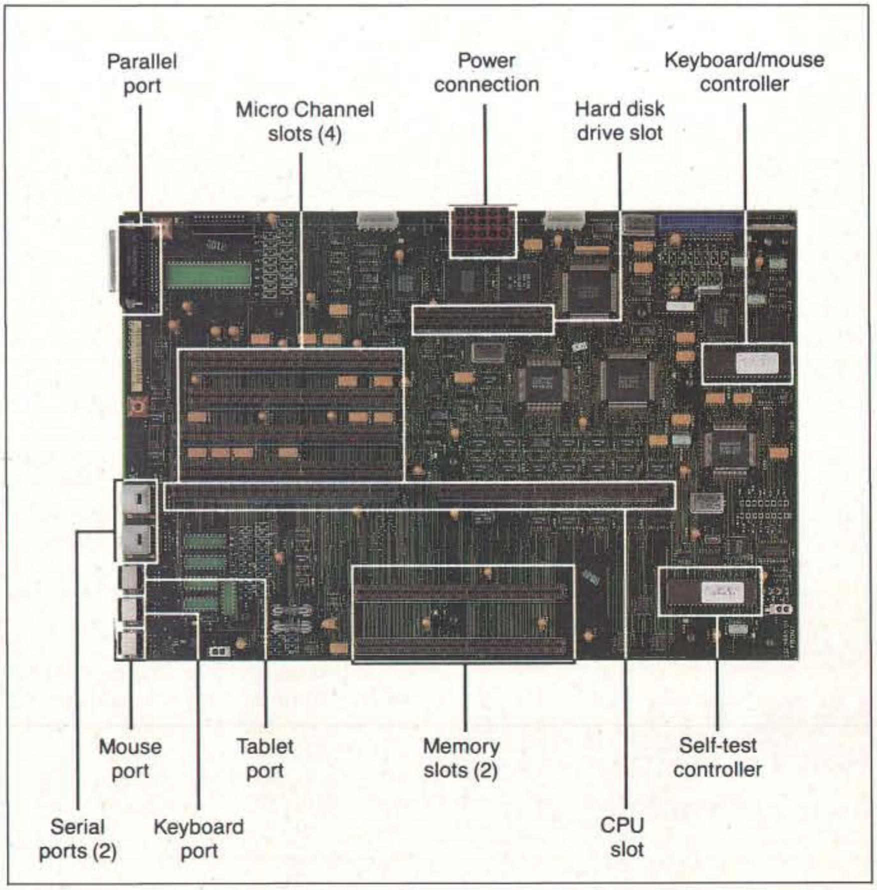


Photo 2: *The desktop system planar. The system planar has slots for the CPU, memory, hard disk drive, and Micro Channel cards, plus a host of I/O connectors.*

COMPANY INFORMATION

IBM
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 890.

systems have 32K bytes of two-way associative cache and a 2-word, or 64-bit, path width from main memory. (The actual data bit width from each memory card is 80 bits—including error-correction and redundant bit lines—while there are 50 lines for 32-bit addresses plus control and parity.) With a CPU speed of 20 MHz, the memory bus bandwidth is 160 MBps.

The nine-chip systems have a 64K-byte four-way associative cache and a memory path width of 128 bits, or 210 bits including addressing and error-correction. The 25-MHz models have a memory bandwidth of 400 MBps, and the 30-MHz model transfers at 480 MBps.

The systems use a segmented memory architecture and support memory locking to prevent processes from interfering with one another. Physically, memory is four-way interleaved and scattered so that no more than 1 bit of each word is located in a single DRAM chip. Logically, memory is split into 4K-byte pages, and real addresses are calculated using a translation look-aside buffer and a page-frame table.

Graphic Evidence

Any of the systems can accept one of several 2-D and 3-D graphics adapters announced with the RISC family. The "entry-level" board is available in two flavors: 4-bit gray-scale (16 shades) or 8-bit color (256 colors from a palette of 16 million). This card uses a single frame buffer and can draw 75,000 2-D vectors per second.

The High-Performance 3-D Color Graphics Processor, codeveloped by IBM and Silicon Graphics, uses technology from the Personal Iris system. The two-slot card is available in 8-bit or 24-bit color versions to allow, respectively, 256 or 16 million colors from a palette of 16 million. It can draw 90,000 2-D vectors and 90,000 3-D vectors per second, and with an optional daughtercard, it can draw 10,000 Gouraud-shaded triangles per second. A second daughtercard option provides z-buffering.

Impressions

To go from the back of the Unix pack to being a leader requires more than snappy hardware. Users want standards, and they need applications. IBM has poured a vast effort into the compiler technology that lets applications take advantage of the RISC CPU. But the company has also chosen to sidestep the popular movement toward a common Unix by enhancing its nonstandard AIX.

To encourage wary third-party developers to port applications to the RISC System/6000, IBM has set up a special porting lab in Austin and will establish others in the U.S. and all over the world. The laboratories are staffed by trained engineers dedicated to each port, and developers are given ample equipment and security. Hundreds of Unix applications have already been ported. The costs of running the centers is no doubt staggering, but they are indicative of IBM's commitment to this product line and to the Unix market.

IBM's previous venture in workstations was unsuccessful, and the company knows it is at least two years behind in the marketplace. To catch up, IBM has thrown everything into the RISC System/6000, including years of engineering, extensive training, and what promises to be a major marketing effort. From our early look, we think the RISC System/6000 stands a good chance of success.

Our technical reservations are few. Will the Micro Channel, even with its improvements, be fast enough for large multiuser applications or very data-intensive graphics? Will AIX suffer in the market for its incompatibility with Unix System V release 4 and lack of multiprocessing support? Will there be enough applications available soon enough? The main concern is whether IBM will be sufficiently nimble to succeed in the fast-paced workstation market. The RIOS project has been marked from the beginning by vacillation and delays. To compete in the RISC market against Sun, Hewlett-Packard, MIPS, and Digital Equipment, IBM can't afford to be risk-averse.

IBM has bested the SPARCStation's price/performance ratio by 2 to 1. Since IBM has hinted at less-expensive members of the RISC System/6000 family in the future, the price/performance ratio will continue to challenge not only competing workstations but high-end PCs as well. ■

Andy Reinhardt is a BYTE associate news editor. Ben Smith is a BYTE technical editor. You can contact them on BIX as "areinhardt" and "bensmith," respectively.

Now you can grab, store, and process 16 images in Real Time on the PC AT.

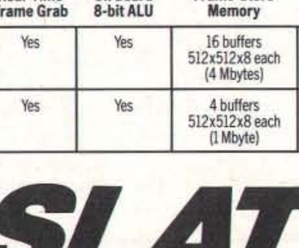
The many faces of Fred Molinari, President

The DT2861 Arithmetic Frame Grabber can process 4 times as many images as any other frame grabber built for the PC AT.

With a built-in processor, the DT2861 also lets you process 4 images in parallel, or switch display instantaneously from as many as 16 images. The DT2861 grabs images off virtually any video source, including CAT scanners, scanning electron microscopes, line-scan cameras, as well as ordinary video cameras and VCRs. It even ships with IRIStutor™ software—free!

For more information about the Frame Grabber that's 4 times better than anything else made for PCs, give us a call today.

Call (508) 481-3700.
In Canada, call (800) 268-0427.



FREE 1990 Image Processing Handbook

Image Processing Board	Computer	Resolution	Gray Levels	RS-170, NTSC, RS-330,CCIR, PAL Compatible	VCR Compatible	Slow Scan	Number of Video inputs	Real-Time Frame Grab	On Board 8-bit ALU	Memory-Mapped Frame-Store Memory	Zoom, Pan, Scroll	Software Support	Price
DT2861 Frame Grabber	IBM PC AT	512x512	256	Yes	Yes	0–12 MHz	8*	Yes	Yes	16 buffers 512x512x8 each (4 Mbytes)	Yes	DT-IRIS IRIStutor Image-Pro	$4995
DT2862 Frame Grabber	IBM PC AT	512x512	256	Yes	Yes	0–12MHz	8*	Yes	Yes	4 buffers 512x512x8 each (1 Mbyte)	Yes	DT-IRIS IRIStutor Image-Pro	$2995

*With DT2859 ½ size multiplexer board ($399).

DATA TRANSLATION®

World Headquarters: Data Translation, Inc., 100 Locke Drive, Marlboro, MA 01752-1192 USA, (508) 481-3700 Tlx 951646
United Kingdom Headquarters: Data Translation Ltd., The Mulberry Business Park, Wokingham, Berkshire RG11 2QJ U.K. (0734) 793838 Tlx 94011914
West Germany Headquarters: Data Translation GmbH, Stuttgarter Strasse 66, 7120 Bietigheim-Bissingen, West Germany 07142-54025
International Sales Offices: Australia (2) 662-4255; Belgium (2) 466-8199; Canada (416) 625-1907; China (1) 868-721 x4017; Denmark (42) 274511; Finland (0) 372144; France (1) 69077802; Greece (1) 361-4300; Hong Kong (5) 448963; India (22) 23-1040; Israel (52) 545685; Italy (2) 82470.1; Japan (3) 502-5550, (3) 348-8301, (3) 555-1111; Korea (2) 756-9954; Netherlands (70) 99-6360; New Zealand (64) 9-545313; Norway (2) 53 12 50; Portugal (1) 545313; Singapore (65) 7797621; South Africa (12) 8037680/93; Spain (1) 455-8112; Sweden (8) 761-7820; Switzerland (1) 723-1410; Taiwan (2) 702-0405.

Circle 83 on Reader Service Card

The Heart and Soul

The right motherboard provides the foundation for high-performance, 25-MHz 386 systems

Steve Apiki, Rob Mitchell, and Stan Wszola

With all the emphasis these days on high-performance storage and video subsystems, it's easy to forget that the ultimate performance enhancement is a new system board. The fastest SCSI drive won't give your applications the boost you expect if the real culprit is a slow CPU or memory architecture.

Virtually all 386 motherboards are designed to run at or close to zero wait states. But the presence of cache memory, or support for interleaving or fast-page-mode DRAM chips, can make a big difference in how a motherboard performs. Of course, performance isn't the only factor separating 386 motherboards. Other features, such as pricing and expandability, vary considerably.

How do the different 386 motherboard designs stack up? To find out, we examined 23 motherboards from 16 different vendors (see tables 1 and 2). All the motherboards support a 25-MHz CPU and include a 25-MHz Intel 80387 math coprocessor. Last year's cutting-edge performers, systems built around the 25-MHz 386, have dropped in price to become an attractive high-performance 386 platform.

Why Test Motherboards?

Replacement motherboards are an appealing alternative to budget-conscious users of XT- and AT-class machines who are looking for an inexpensive way to move up to a 386. Depending on your existing hardware, you could save substantially over the cost of a new system. But you might have some problems integrating the new motherboard into a system with components that are designed for older, slower systems.

If you plan to build a system from the ground up, the savings will probably be disappointing. Major PC clone vendors buy components by the truckload and can offer assembled systems for less than the retail cost of all the parts. The main advantage of assembling your own system isn't monetary; it's an intimate understanding of what's in your machine and how it fits together. You can build your system to your exact specifications using the components that will produce the best performance or greatest economy.

But the relative merits of 386 motherboards aren't just topics for the do-it-yourselfer. If you're thinking of buying a system, you will find that third-party motherboards offer an excellent basis of comparison among clone machines. Many PC clone vendors pride themselves on using name-brand graphics adapters, monitors, and hard disk drives. But the motherboard isn't as likely to be from a well-known manufacturer—and even when it is, information about a given motherboard is often hard to find.

We tested both cached and noncached designs and both XT- and AT-size motherboards. You won't find all these motherboards at the corner computer store, or even in the back pages of BYTE. Intel and Mylex, for example, sell only to value-added resellers (VARs). But other vendors, such as Jameco and JDR Microdevices, sell both directly to end users and through dealers.

Most vendors offer a bare-bones motherboard configuration that includes a 25-MHz Intel 386 CPU and no DRAM. If the motherboard includes a cached-memory system, it includes at least 32K bytes of static RAM.

List prices vary, depending on configuration, vendor reputation, and distribution channel. Cache motherboards cost more than noncached models, and name-brand motherboards like Mylex's MWS 386-25 and Jameco's JE3026 (which is actually made by American Megatrends, Inc. and is identical to 25-MHz AMI motherboards found in many compatibles) cost substantially more than lesser-known brands. Motherboards sold through dealers and VARs have higher list prices than boards available directly from the manufacturer, but they generally sell at a discount.

To make comparisons easier, we've made two features tables: table 1 for caching motherboards, and table 2 for noncaching motherboards. Most of those with a cache ranged in price from $1100 to $2000 with no RAM. The least-expensive cached product was Nascent's NT-386-25 ($1049), and the most expensive was Intel's Model 302 ($4091), which included 2 megabytes of RAM. Noncaching boards started at $765 and went up to $2095 for the Seattle STD 386XT, which comes standard with 1 MB of RAM.

The Proving Ground

We tested each motherboard for two things: performance and physical compatibility. Determining the latter merely meant installing each motherboard in a generic AT-size case to check for correct size and proper lo-

# of a PC Compatible

cation of the holes for mounting standoffs and screws. Every board fit into the case, although some just squeaked by our AT's disk drive housing.

To test performance, we set up a test system consisting of the following peripherals: a 250-watt power supply, a Western Digital WD1006V-MM1 hard disk drive controller card, a Seagate ST-251-1 40-MB hard disk drive, a Jameco JE1077 floppy disk drive controller/serial/parallel card, a TEAC FD-55GFR 5¼-inch 1.2-MB floppy disk drive, an AST VGA Plus video card, a Key Tronic KB 101 keyboard, and one of several color VGA monitors.

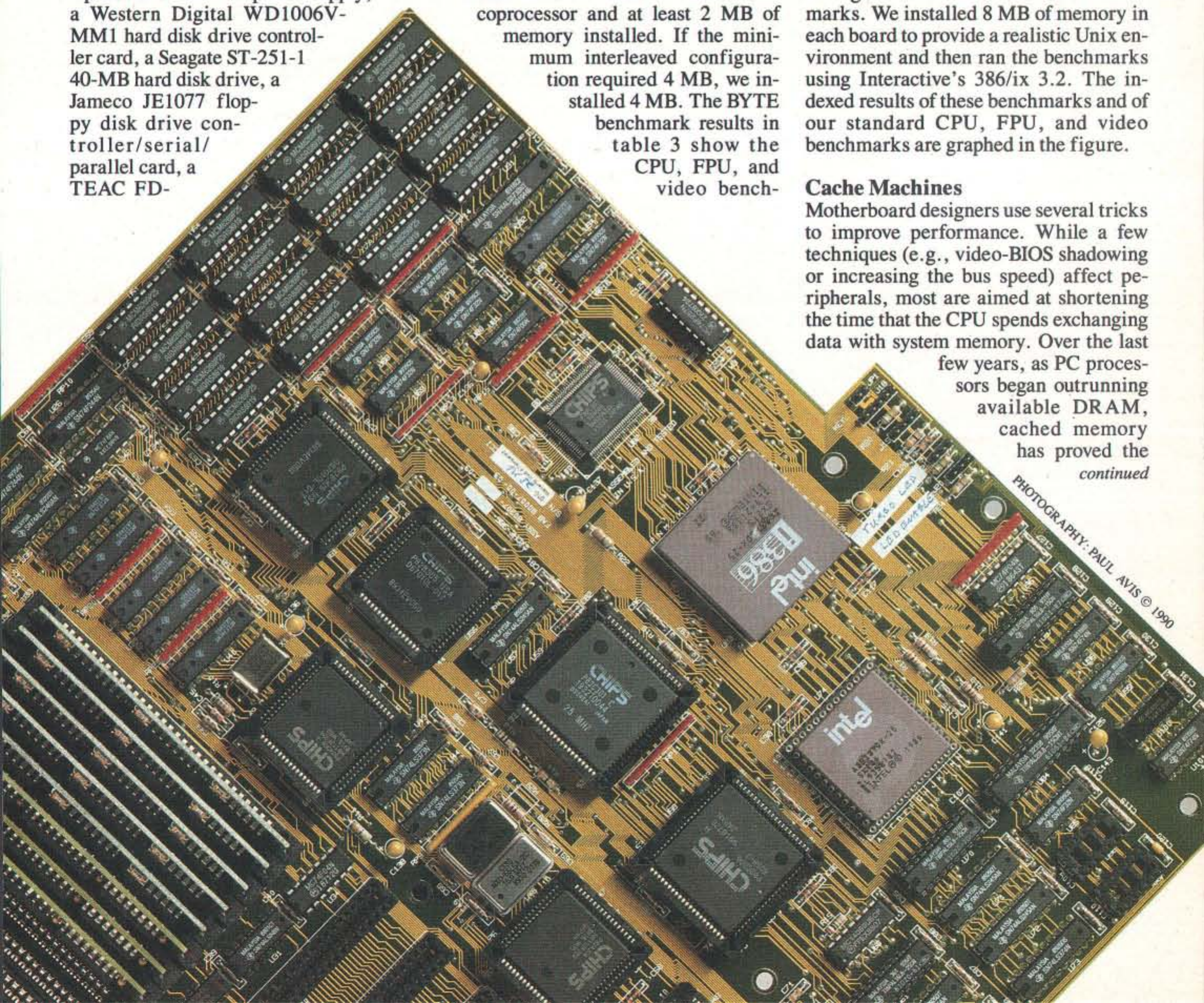
We hooked each motherboard into this test-bed in turn. We tested each board under DOS 3.3 with an Intel 80387 coprocessor and at least 2 MB of memory installed. If the minimum interleaved configuration required 4 MB, we installed 4 MB. The BYTE benchmark results in table 3 show the CPU, FPU, and video benchmark indexes and ratings from the conventional Dhrystone and Livermore Loops tests.

To gauge the effectiveness of these boards when running large, protected-mode applications, we also put them through a run of the BYTE Unix benchmarks. We installed 8 MB of memory in each board to provide a realistic Unix environment and then ran the benchmarks using Interactive's 386/ix 3.2. The indexed results of these benchmarks and of our standard CPU, FPU, and video benchmarks are graphed in the figure.

Cache Machines

Motherboard designers use several tricks to improve performance. While a few techniques (e.g., video-BIOS shadowing or increasing the bus speed) affect peripherals, most are aimed at shortening the time that the CPU spends exchanging data with system memory. Over the last few years, as PC processors began outrunning available DRAM, cached memory has proved the

continued



PHOTOGRAPHY: PAUL AVIS © 1990

CACHING 25-MHz 386 MOTHERBOARDS

Table 1: Features of caching 25-MHz 386 motherboards. Boards are differentiated by nonperformance features (e.g., expandability and flexibility of configuration) as well as by performance-enhancing features (●=yes; ○=no).

Motherboard	Manufacturer	List price	Board size (inches)	CPU speeds (MHz)	System bus speed (MHz)	Expansion slots	Math coprocessors[1]	ROM BIOS (date)	BIOS Shadow RAM	Video Shadow RAM	386 chip set
Atronics ATI-386/B	Atronics International	$1295[3]	18½ × 12	8, 25	8	2 8-bit, 6 16-bit, 1 32-bit	80387-25, 1167-25, 80287-10	AMI EC&T 5286 (4-20-88)	●	○	ATI
C^2 M-386-25	C^2 Micro Systems	$1300	12 × 13¾	6, 8, 25	8	2 8-bit, 5 16-bit, 1 8-/32-bit	80387-25,[4] 1167-25	Award M386-25/33 (8-25-89)	●	●	Discrete logic
Cache 386-25	Cache Computers	$1100	12 × 13¾	8, 25	8, 8.3, 12.5	1 8-bit, 7 16-bit	80387-25, 3167-25	AMI E307 6063 (9-15-89)	●	●	C&T
DTK Cache 386-25	DTK Computer	$1649[5] $2149[6]	12 × 13¾	10, 25	6, 12	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	DTK 4.25 (6-12-89)	○	○	Discrete logic
Intel Model 302	Intel	$4091[7]	12 × 13⅖	8, 25	8	1 8-bit, 5 16-bit, 2 8-/16-/32-bit	80387-25, 3167-25	Phoenix 1.10 04.C1 (1-15-88)	●	●	Discrete logic
Jameco JE3026	AMI	$1900	12 × 13¾	8, 25	8	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	AMI DAMI 3607 (4-25-89)	●	●	Discrete logic
Jameco JE3525	Elite Group	$1200	8½ × 13	8, 25	8	1 8-bit, 4 16-bit, 1 32-bit	80387-25, 3167-25	AMI EC&T 1131 (8-30-89)	●	●	C&T
JCS 386c	JC Information Systems	$1100	8½ × 13	8, 25	8	1 8-bit, 5 16-bit, 1 8-/32-bit, 1 16-/32-bit	80387-25, 3167-25	Phoenix 1.10.02 (1-15-88)	●	●	C&T
JDR C386-25	Modular Circuit Technology	$1199[9]	8½ × 13	16, 25	8	3 8-bit, 4 16-bit, 1 32-bit	80387-25, 3167-25	AMI EC&T 1131 (2-25-89)	●	●	C&T
Micronics 80386-I Cache	Micronics Computers	$1500	12 × 13¾	6, 8, 25	8.3, 12.5	2 8-bit, 5 16-bit, 1 32-bit	80387-25, 3167-25[10]	Phoenix 1.10.10A (1-15-88)	●	● (EGA only)	Discrete logic
Monolithic MicroFrame 386CT	Monolithic Systems	$1945	8½ × 13	10, 25	8.3, 10, 12.5	6 16-bit, 2 8-/16-/32-bit	80387-25, 3167-25	Quadtel CS8231 3.03.03 (8-09-89)	●	●	C&T
Mylex MWS 386-25	Mylex	$2100	12 × 13¾	8, 25	6.25, 8.33, 12.5	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25[10]	Phoenix 1.10.10 (11-15-88)	○	○	Discrete logic
Nascent NT-386-25	Nascent Technology	$1049	12 × 13¾	8, 25	8	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 3167-25	AMI 1400 (8-15-88)	○	○	Discrete logic
OEM 386-25MX	OEM	$1295	12 × 13¾	8, 25	8, 10	1 8-bit, 6 16-bit, 1 8-/32-bit	80387-25, 1167-25	AMI 5301 (12-15-88)	●	●	C&T
Orchid Privilege 386/Cache	Orchid Technology	$1398	12 × 13¾	8, 25	8	2 8-bit, 5 16-bit	80387-25, 3167-25	AMI DC&T 5025 (4-30-89)	●	●	C&T

Note: Base price includes CPU.
[1]All motherboards support only one math coprocessor at a time unless footnoted.
[2]Tested type listed first.
[3]Base price includes 1 MB of RAM.
[4]Supports both coprocessors simultaneously.
[5]64K-byte-cache version.
[6]256K-byte-cache version.

most effective method for enhancing high-speed board performance.

Not surprisingly, cached boards in our tests decidedly outperformed their non-cached counterparts. On both DOS and Unix CPU tests, the 16 caching models finished well ahead of the seven that did not use caches. The trend continued for our Dhrystone tests as well.

While some cache is always better than no cache, a clear winner among caching schemes is not easy to find. The boards that we benchmarked employed a handful of common caching methods, and different tests favored different methods.

All caches work by keeping frequently accessed data in a small amount of very fast static RAM. They are effective because, statistically, programs tend to spend most of their time within a small range of memory addresses. Cache implementations differ, however, in how they organize data, when they write to main memory, and how large a cache they require.

About one-half of the cached boards (nine) used a direct-mapped cached organization; the remainder used two-way set-associative caches. Although other types exist, these two are by far the most common in current PCs.

Direct-mapped caches assign a dis-

Memory							Cache memory					Warranty (years)	Source
Geometry	Package	Speed (ns)	RAM types[2]	Interleave	Maximum on-board RAM (MB)	Maximum 32-bit RAM (MB)	Controller	Cache organization	SRAM speed (ns)	Tested size (bytes)	Other size (bytes)		
256K × 9 1Mb × 9	SIMM	80	RAS/CAS, page-mode, static-column	○	8	16	Proprietary	Direct-mapped write-through	25	64K	32K	1	Dealers, VARs
1Mb × 1	DIP	100	Page-mode, RAS/CAS	○	4	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct, VARs
256K × 9 1Mb × 9	SIMM	80	RAS/CAS, static-column	○	16	16	C&T 82C307	Two-way set-associative posted-write	25	32K	None	1	Dealers, VARs
256K × 1 256K × 4 1 Mb × 1 256K × 9 1Mb × 9	DIP SIP	80	RAS/CAS, page-mode, static-column	○	8	16	Proprietary	Direct-mapped write-back	25	64K, 256K	None	1	Direct, dealers, VARs
256K × 9 1Mb × 9	SIMM	100	Page-mode, RAS/CAS, static-column	○	8	40	Proprietary	Direct-mapped posted-write	35	64K	None	1	VARs
1Mb × 1 256K × 1 256K × 9 1Mb × 9[8]	DIP SIMM	70	RAS/CAS, page-mode, static-column	●	8	24	Proprietary	Direct-mapped write-through	25	64K	None	1	Direct
256K × 9 1Mb × 9	SIP	80	RAS/CAS	●	0	16	Intel 82385	Two-way set-associative write-through	35	32K	None	1	Direct
256K × 4 1Mb × 1 1Mb × 9	DIP	100	Page-mode	○	0	32	C&T 82C307	Two-way set-associative write-through	25	32K	None	1	Direct, dealers, VARs
256K × 1 1Mb × 1	DIP	60	RAS/CAS	●	0	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct
256K × 1 1Mb × 1	DIP	80	RAS/CAS, page-mode, static-column	○	0	16	Intel 82385	Direct-mapped posted-write[11]	35	32K	64	1	Direct, dealers, VARs
256K × 9 1Mb × 9	SIP	100	Page-mode	○	8	24	C&T 82C307	Two-way set-associative posted-write	25	32K	None	5	Direct, dealers, VARs
256K × 9 1Mb × 9	SIMM	80	RAS/CAS	○	8	16	Proprietary	Direct-mapped write-through	25	64K	None	1	Dealers, VARs
256K × 9 1Mb × 9	SIMM	80	RAS/CAS	○	8	16	Proprietary	Direct-mapped write-back	25	64K	256K	2	Dealers, VARs
256K × 4 256K × 1[8]	DIP	70[12]	Page-mode	●	8	16	Intel 82385	Two-way set-associative write-through	25	32K	None	1	Direct
256K × 9 1Mb × 9	SIMM	80	RAS/CAS	●	16	16	Intel 82385	Two-way set-associative posted-write	35	32K	None	2	Dealers, VARs

[7]Base price includes 2 MB of RAM.
[8]Motherboard will support 4-megabit chips when available.
[9]Memory board required, not included ($99).
[10]Optional daughtercard supports both Intel 80387 and Weitek 3167 coprocessors.
[11]Can be configured as two-way set-associative with additional static RAM.
[12]80-ns chips are standard.

tinct set of memory locations to each cache *line* (a line is 4 bytes long for these boards). The main memory locations mapped to each cache slot are grouped by the least significant part of their addresses; the effect is that each cache location can contain data only from each *n*th memory address, where *n* is the length of the cache in lines. Each memory location, therefore, has only one corresponding cache slot; the processor need only check one location to determine if a hit or a miss has occurred. This fast hit/miss determination is the strength of the direct-mapped method. Unfortunately, because each memory location must share a cache slot with several other main memory addresses, it's possible that some useful data will get bumped out, forcing the CPU to access main memory.

Two-way set-associative cache designs reduce the likelihood of this problem by having two slots available for each memory location. A cache of this kind is like two direct-mapped caches in parallel. This system has two disadvantages: First, each set is only half the size of an equivalent direct-mapped cache; and second, the processor must look in two places to determine whether a hit or a miss has occurred.

Memory-write methods also affect

continued

NON-CACHING 25-MHz 386 MOTHERBOARDS

Table 2: Features of noncaching 25-MHz 386 motherboards. As with table 1, boards are often differentiated by nonperformance features (●=yes; ○=no).

Motherboard	Manufacturer	List price	Board size (inches)	CPU speeds (MHz)	System bus speed (MHz)	Expansion slots	Math coprocessors[1]	ROM BIOS (date)	BIOS Shadow RAM	Video Shadow RAM	386 chip set
C² MBI386A+	C² Micro Systems	$765	12 × 13¾	16, 25	8.3, 10.3	1 8-bit, 6 16-bit, 1 32-bit	80387-25, 1167-25 with 80287-8 socket[3]	AMI EC&T 1164 (3-03-89)	●	●	C&T
C² Baby 386 Mainboard	C² Micro Systems	$775	8½ × 12¾	20, 25	8.3, 6.7	3 8-bit, 4 16-bit, 1 16-/32-bit	80387-20	AMI EC&T 1030 (3-03-89)	●	●	C&T
JCS 386i	JC Information Systems	$850	8½ × 13	8, 25	8	2 8-bit, 5 16-bit, 1 16-/32-bit	80387-25, 1167-25	Phoenix 1.10.02B (1-15-88)	●	●	C&T
JDR M386-25	Modular Circuit Technology	$799	8½ × 13	16, 25	8	2 8-bit, 5 16-bit, 1 32-bit	80387-25	AMI EC&T 1131 (3-03-89)	●	●	C&T
JDR 386-MB-25S	Modular Circuit Technology	$799	12 × 13¾	16, 25	8.3, 12	3 8-bit, 5 16-bit	80287-8, 80387-25, 3167-25	AMI EC&T 1102 (3-03-89)	●	●	C&T
Pioneer VMB-386/25	Pioneer Computer	$789	8¾ × 12	8, 25	8	2 8-bit, 5 16-bit	80387-25, 3167-25	AMI 6802 (9-15-89)	●	●	C&T
Seattle STD 386XT	Seattle Telecomm and Data	$2095[4]	8½ × 12	8, 25	8	3 8-bit, 4 16-bit, 1 8-/32-bit	80387-25[5]	Quadtel CS2386 3.04.01 (9-20-89)	●	●	C&T

[1]All motherboards support only one math coprocessor at a time unless footnoted.
[2]Tested type listed first.
[3]Motherboard will support 4-megabit chips when available.
[4]Base price includes 1 MB of RAM.
[5]80387 and 386 in daughtercard plugged into 386 socket. 80287 socket is an option.

cache performance. A cache can follow a simple write-through policy, in which each write operation is carried out to both cache and main memory. A more sophisticated approach, *posted write-through*, frees the main processor after the cache write; the main memory write is carried out independently by the cache controller. Write-back, the most complex scheme, updates main memory only when a modified entry is dumped from the cache.

Cache size is the last critical factor. Large caches mean better performance, but there is a very steep diminishing-returns curve after a certain size. That critical size differs for each application, but several manufacturers statistically estimate a 95 percent cache hit rate for 32K-byte caches.

Six of the boards that we tested used Intel's 82385 cache controller. Although the 82385 can be configured for either direct-mapped or two-way set-associative operation, only the Micronics board ran the unit in direct-mapped mode. Micronics lets you set the cache organization as an option, but you must double the standard static RAM to 64K bytes to use a two-way set-associative cache.

JC Information Systems' JCS 386c, the Monolithic MicroFrame, and the Cache 386-25 used Chips & Technologies' 82C307 cache/memory controller instead. The 82C307 also allows two-way set-associative cache control of up to 32K bytes.

The other boards went with proprietary cache designs, all of which were direct-mapped. Intel, ironically, passed over its 82385 in favor of a proprietary cache controller design for the Model 302. DTK's board lets you install a cache of up to 256K bytes, and it and the Nascent are the only models to implement a write-back cache.

Our benchmarks show some correlation between cache type and effectiveness, but the presence or absence of a cache is still a much stronger indicator of performance. DOS tests, which are relatively small programs, reacted more favorably to the smaller, two-way set-associative caches than to the large direct-mapped designs. The top six finishers on our DOS benchmarks (the top six in table 3) all used this design.

Jameco's JE3525 and the Mylex MWS 386-25 performed significantly poorer in the DOS benchmarks than other cached boards. The aberration is surprising, considering that their basic memory configuration is similar to that of boards that outperformed them. These two suffered the most on low-level string move operations, but they handled algorithms like the Sieve of Eratosthenes almost as well as other cached boards.

The Dhrystone test showed more of an affinity for cache size than for cache type. DTK's 256K-byte board finished on top, and the two next highest performers had 64K-byte caches. These three also shared a write-back cache.

Under Unix, large, direct-mapped caches seemed to fare better than they did under DOS. All the cached boards clustered very tightly on these tests, however, and the difference in scores between the best and the worst cached boards is far less than the gap between the slowest caching unit (the Mylex MWS 386-25) and the best noncached board (the JDR 386-MB-25S).

The Interleave Alternative

Noncached boards are an attractive alternative to the pricier cached models, if top performance isn't your driving requirement. The least expensive of these boards can be had for $765, and, of course, any of these boards will still run rings around an AT.

The seven noncached boards that we tested all make use of memory-bank interleaving to strengthen memory performance. Several of the cached boards also use interleaving to back the cache.

One of the critical delays in accessing DRAM is recharge time, which must occur between successive accesses to the same chip. The interleave solution puts

Memory							Warranty (years)	Source
Geometry	Package	Speed (ns)	RAM types²	Interleave	Maximum on-board RAM (MB)	Maximum 32-bit RAM (MB)		
256K × 4 256K × 1 1 Mb × 1	DIP	80	RAS/CAS, page-mode, static-column	•	10	16	1	Direct, VARs
256K × 9 1Mb × 9	SIP	80	RAS/CAS, page-mode	•	8	16	1	Direct, VARs
256K × 4 1Mb × 4 256K × 9 1Mb × 9	DIP SIMM	80	Page-mode	•	8	16	1	Direct, dealers, VARs
256K × 9 1Mb × 9	SIP	80	RAS/CAS	•	8	16	1	Direct
256K × 9 1Mb × 9 1Mb × 1	SIP DIP	80	RAS/CAS	•	16	16	1	Direct
256K × 9 1Mb × 9	SIMM	60	Page-mode	•	8	8	2	Dealers, VARs
256K × 9 1Mb × 9	SIP	60	Page-mode	•	8	16	1	Direct

one-half of the addresses (even) in one bank and the other half (odd) in another; if reads or writes occur sequentially, one bank can be recharging while the other is being accessed. Unfortunately, boards that use this scheme require that you fill the memory banks in pairs. On many boards, this means that you must have either 2 or 8 MB of memory to get reasonable performance. In some preliminary tests, we found that the difference between interleaved and noninterleaved performance was 15 percent to 20 percent.

Pioneer's VMB 386/25, Seattle Telecomm's STD 386XT, and the JCS 386i use *page-mode* DRAMs for added speed. Normal (row address strobe/column address strobe, or RAS/CAS) DRAM chips require that both row and column select lines be strobed for each access. Page-mode DRAMs can skip the RAS precharge time when making successive reads or writes to memory locations with the same row address (i.e., in the same "page"). Pages are 2K bytes in size for 256K-byte DRAMs; this gives you a 2K-byte range of consecutive addresses that can be accessed much more quickly than with normal DRAMs. Boards that interleave page-mode DRAMs interleave not addresses but entire pages, for a much higher probability of fast access.

Some of the cached boards also use, or can also accept, page-mode DRAMs. C²'s MBI386A+ board and several cached models will also accept *static-column* RAM, which is like page-mode memory but doesn't require a column address strobe between successive reads. Intel claims a 7 percent improvement for static-column over page-mode DRAM and a 7 percent performance difference between page-mode and normal DRAM.

Our benchmarks show little correlation between use of page-mode DRAMs and superior performance. The seven noncaching boards, page-mode or not, performed very much alike under Unix. Under DOS, five of the motherboards were nearly identical, while the (page-mode) STD 386XT and (standard) C² MBI386A+ boards were disappointingly slow.

Beyond the CPU

Fast memory architecture could not make as much of a contribution to our floating-point and video benchmarks. As a result, the cached/noncached distinction is not nearly as severe.

DOS FPU benchmarks showed a smooth transition between cached and noncached units, with cached models still somewhat faster. The two results that stand apart are negative: Atronics' ATI-386/B was surprisingly weak for a cached board, and the noncaching C² Baby 386 Mainboard, which could run its 80387 at only 20 MHz, finished dismally far behind the rest of the pack. Unix Float benchmark results confirmed the DOS numbers.

The Livermore Loops test, which doesn't concentrate on pure 80387 instructions quite as much as our FPU benchmark does, showed a similar but slightly broader spread. Again, C²'s Baby 386 Mainboard lagged.

Our final test was BYTE's video suite. Originally, we intended it to be a measure of bus throughput, but instead it pointed out the effectiveness of video BIOS shadowing.

The graphics portions of our test ran similarly on all the boards. Since all buses were configured at or near 8 MHz, there was little room for variation.

But our text tests, which rely heavily on the BIOS, showed drastic differences from board to board. The benchmark uses cursor-positioning BIOS calls to move the cursor around the screen; on this test, the difference between shadowed and not-shadowed performance was on the order of 2 or 3 to 1.

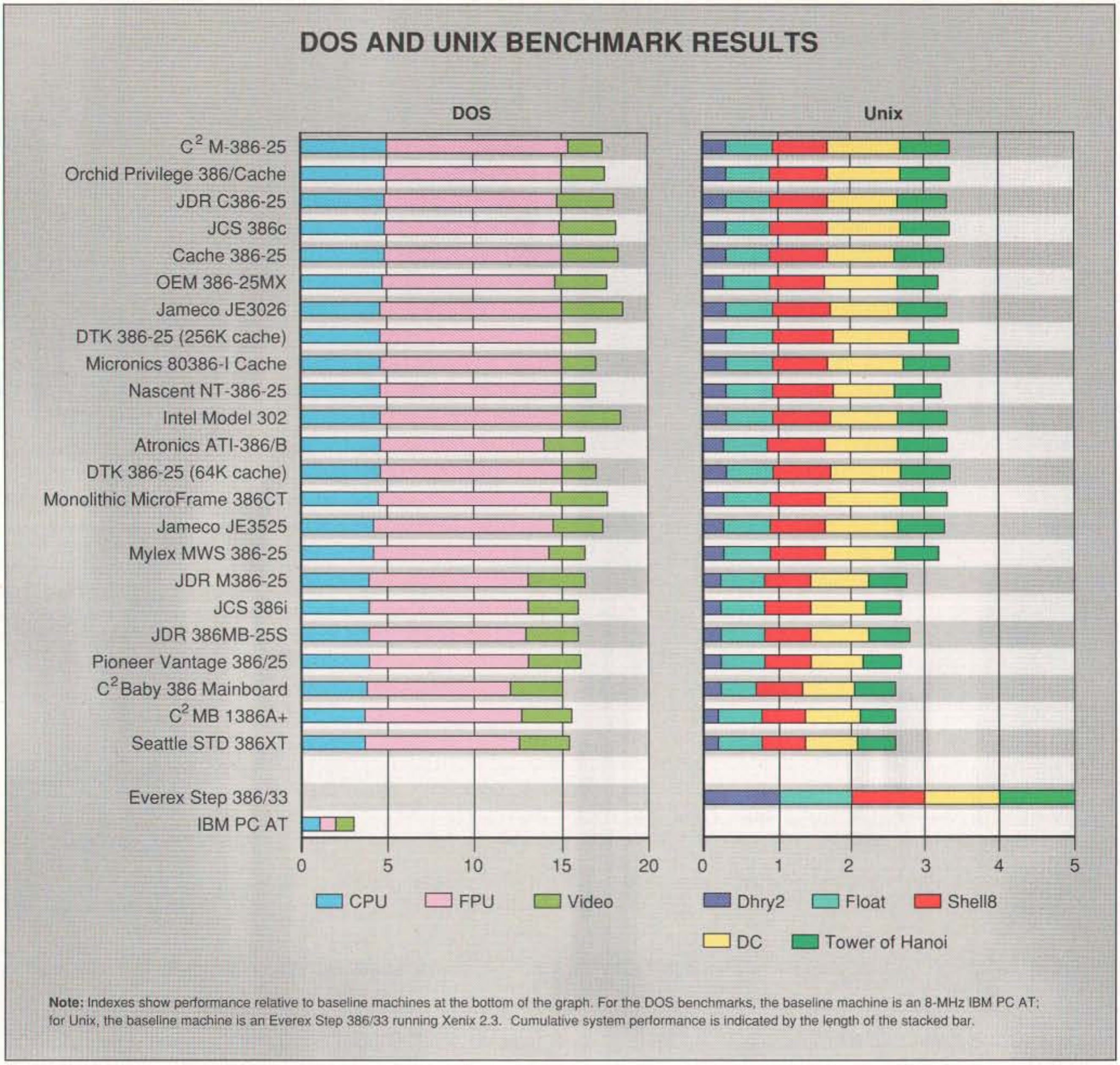
Installation Basics

All the motherboards that we tested came preconfigured with each vendor's recommended memory configuration. But since most boards don't include any memory as standard, you'll face a variety of memory options. A 25-MHz motherboard requires fast RAM, typically with access times of 60 to 100 nanoseconds. Your best bet is to stick with the vendor's recommendations here. You can use slower, less expensive RAM chips, but that adds CPU wait states, which defeats the purpose of buying a fast computer. If you're upgrading to a board that will accept dual-in-line package (DIP) DRAMs, don't give in to the temptation to reuse 150-ns RAM from that old AT—the cost savings isn't worth the performance penalty that you will pay.

A few motherboards, such as C²'s M-386-25 and the JCS 386c, require page-mode DRAMs. Other motherboards accept standard RAS/CAS or page-mode DRAMs, but the slight increase in performance that you'll get by buying page-mode DRAMs probably isn't worth the extra cost. Several vendors also support even faster—and more expensive—static-column DRAMs as an option.

Most of the motherboards that we tested support 16 MB of 32-bit memory through a combination of on-board RAM and 32-bit memory boards. That is no coincidence. Most manufacturers used

continued



DOS and Unix benchmark performance for each motherboard, shown here ranked by DOS CPU index. While Unix test results showed less difference than DOS tests, both clearly indicate the value of cached memory.

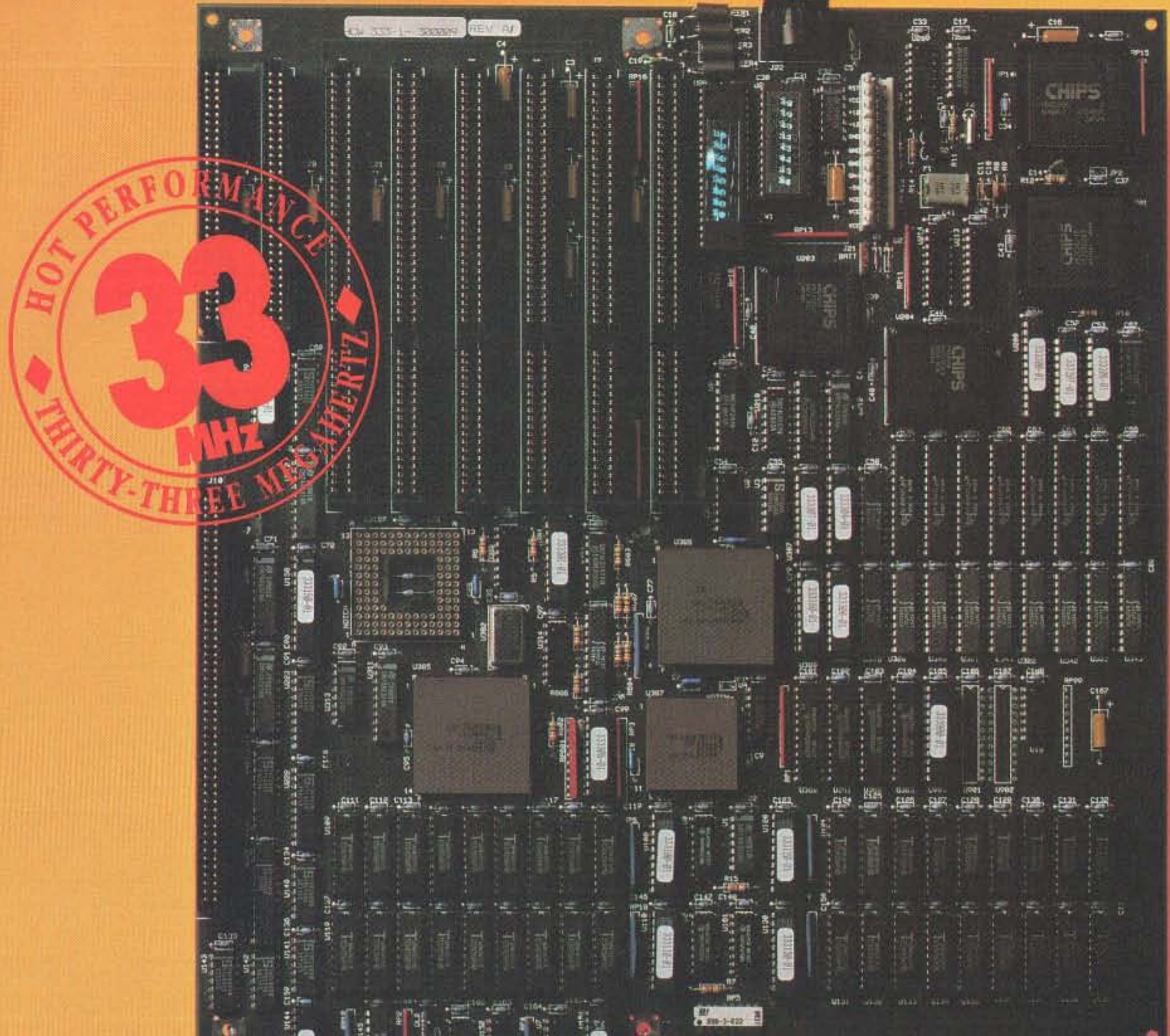
Chips & Technologies' 386/AT chip set, which can address up to 16 MB of 32-bit RAM. While Chips & Technologies' 82C307 cache/memory controller can address up to 64 MB of RAM, none of the motherboards that used it supported that much memory. The Cache 386-25 accepted 16 MB, while the Monolithic MicroFrame and JCS 386c supported 24 MB and 32 MB, respectively. Intel's Model 302 had the largest memory capacity. It used two 32-bit expansion slots to support up to 40 MB of RAM. Pioneer's VMB-386/25 motherboard, on the other hand, didn't have any 32-bit expansion slots and supported only the 8 MB that will fit on-board. Other boards that put all the system memory on the motherboard—the Orchid Privilege 386/Cache and the Cache 386-25—accommodated 16 MB of on-board RAM.

The most common memory ceiling on the boards that we tested was 8 MB of on-board RAM and 8 MB on a 32-bit add-in card. But some manufacturers put all system memory on add-in cards and used 256K-byte or 1-MB single in-line memory modules (SIMMs) or single in-line package (SIP) modules to save space. Jameco and JC Information Systems included an empty memory card with their base systems. Micronics' base model also had a memory card, but if you need more than 8 MB, you have to buy a piggyback card (which comes with 4 MB of RAM) for $795. JDR Microdevices charges an additional $99 for its memory board with no RAM.

Unfortunately, when it comes to 32-bit memory cards, there is no standard; you can't use one company's 32-bit memory card in another motherboard's 32-bit memory slot. With the rapid advances in motherboard technology and the high turnover in new versions of motherboards, you should consider getting a 32-bit memory card when you purchase your motherboard. Delaying the purchase may make getting an expansion card difficult or impossible.

Most boards accepted some combination of DIPs and either SIMMs or SIPs. Both of C²'s full-size entries, JDR's

continued



IT Hz SO GOOD!

INTRODUCING HAUPPAUGE'S 33MHz SYSTEM BOARDS.
If your computer feels slow, we know where it hertz. For a fast cure, get our new 386 MotherBoard/33MHz. We've built in 4 Megabytes of high speed RAM, 64K of RAM cache, and both 387 Weitek math coprocessor sockets. This board makes your 386 computer the fastest PC available!

Network Savvy. With the 386 MotherBoard/33MHz, you can build a file server or workstation that makes Novell networks *scream.* Enjoy compatibility with Token Ring, Arcnet, Ethernet, and other network cards.

The UNIX Engine. Great for VARS, Systems Integrators and UNIX OEMs, the Hauppauge 386 MotherBoard/33MHz runs SCO Xenix, Interactive 386/ix and AT&T's UNIX System V. With its PC/AT compatible I/O system, our 33MHz board accommodates the latest in disk control, graphics, and network I/O cards.

CAD Capability. Do your AutoCAD and other CAD programs seem slow? The 386 MotherBoard/33MHz boosts your math and graphics applications, and supports the high speed 387-33 and 33MHz Weitek math coprocessors.

Technical Features. The 386 MotherBoard/33MHz includes:
- 4 Megabytes of high speed 32-bit memory, expandable to 64 Megabytes
- 64K of 20 nsec cache memory
- Six 16-bit expansion slots, one 8-bit and one 8-bit/32-bit slot
- PC/AT compatible I/O system for support of OS/2 and UNIX.

Yes, send me your product information!

Name____________________

Company____________________

Address____________________

City, State, Country____________________

Telephone____________ Zip Code____________

Mail Coupon to:

Hauppauge Computer Works, Inc.
175 Commerce Drive
Hauppauge, New York 11788, U.S.A.
Tel: 01-516-434-1600
Fax: 01-516-434-3198

or: Hauppauge Computer Works, GmbH
Hansaallee 201
4000 Dusseldorf 11, West Germany
Tel: 0211-594320
Fax: 0211-593908

For more information call Hauppauge, (516) 434-1600. In Europe: (49) 211-594320.

Hauppauge!

Hauppauge Computer Works
Your high performance 386 Supplier

Circle 132 on Reader Service Card

BENCHMARK RESULTS

Table 3: BYTE benchmark results. Conventional benchmarks and indexes provide a quick summary of performance, while the raw numbers for our CPU benchmarks give a clearer picture of where differences lie. For example, low-level operations like byte-wide moves show considerably greater difference from board to board than high-level algorithms like the Sieve of Eratosthenes.

	BYTE CPU benchmarks								Indexes			Conventional	
		String moves					Sieve	Sort	CPU	FPU	Video	Dhrystones (Dhry./sec.)	Livermore Loops (MFLOPS)
	Matrix	Byte-wide	Word-wide		Doubleword-wide								
Motherboard			Odd	Even	Odd	Even							
C² M-386-25	2.70	16.77	22.46	8.40	16.48	4.20	14.22	10.71	4.94	10.46	1.97	8130	0.2135
JDR C386-25	2.69	17.08	22.98	8.55	16.59	4.28	14.23	10.71	4.89	9.88	3.26	7987	0.2037
Orchid Privilege 386/Cache	2.71	17.10	22.92	8.57	16.58	4.29	14.23	10.72	4.89	10.18	2.43	7987	0.2101
JCS 386c	2.71	16.72	22.90	8.37	16.64	4.17	14.72	10.98	4.88	10.03	3.31	7987	0.2082
Cache 386-25	2.72	16.70	22.92	8.35	16.69	4.18	14.68	11.02	4.88	10.12	3.34	7987	0.2084
OEM 386-25MX	2.80	18.27	24.62	9.13	18.03	4.56	14.35	10.78	4.69	10.01	2.89	7788	0.2083
Jameco JE3026	2.67	20.23	23.16	10.13	17.19	5.08	14.03	10.63	4.64	10.44	3.45	8064	0.2157
DTK Cache 386-25 (256K-byte cache)	2.62	21.18	22.90	10.57	17.60	5.31	14.28	10.71	4.58	10.50	1.94	8431	0.2158
Nascent NT-386-25	2.61	21.42	22.81	10.71	17.41	5.38	14.28	10.63	4.57	10.46	1.96	8347	0.2158
Micronics 80386-I	2.71	20.95	23.69	10.47	16.53	5.22	13.93	10.62	4.57	10.47	2.00	8051	0.2165
Intel Model 302	2.69	21.50	23.59	10.73	18.02	5.38	14.04	10.66	4.53	10.47	3.41	8130	0.2150
Atronics ATI-386/B	2.77	20.71	22.70	10.38	17.59	5.18	14.74	11.02	4.53	9.51	2.27	7776	0.1974
DTK Cache 386-25 (64K-byte cache)	2.66	21.86	23.29	10.89	17.80	5.44	14.30	10.67	4.51	10.58	1.93	8264	0.2155
Monolithic MicroFrame 386CT	2.75	21.03	24.11	10.51	16.79	5.27	14.77	11.04	4.46	9.87	3.29	7911	0.2076
Jameco JE3525	2.75	26.47	23.73	13.23	17.25	6.63	14.28	10.78	4.19	10.30	2.93	7587	0.2144
Mylex MWS 386-25	2.79	24.88	24.80	12.47	18.59	6.20	14.94	11.37	4.16	10.07	2.07	7407	0.2035
JDR M386-25	3.62	23.66	22.67	11.83	16.73	5.95	16.26	14.81	3.88	9.25	3.17	6459	0.1920
JCS 386i	3.59	23.76	22.85	11.88	16.83	5.95	16.29	14.83	3.87	9.20	2.84	6410	0.1918
JDR 386-MB-25S	3.63	23.76	22.85	11.92	16.82	5.95	16.29	14.83	3.86	9.12	2.94	6410	0.1918
Pioneer VMB-386/25	3.66	23.75	22.85	11.90	16.83	5.95	16.29	14.83	3.86	9.17	3.04	6410	0.1919
C² Baby 386 Mainboard	3.70	23.74	23.68	11.92	16.80	5.99	16.35	15.00	3.82	8.26	2.93	6321	0.1695
C² MBI386A+	3.82	24.81	23.25	12.41	17.01	6.21	16.63	15.93	3.71	8.98	2.92	6150	0.1884
Seattle STD 386XT	3.90	24.82	24.08	12.43	16.97	6.22	16.73	16.09	3.67	8.93	2.89	5767	0.1886
IBM PC AT	11.69	80.41	80.41	40.26	N/A	N/A	73.65	84.39	1.00	1.00	1.00	1721	0.0237

All CPU benchmark times are in seconds.
For indexes, Dhrystones, and Livermore Loops, higher numbers indicate better performance.
N/A = Not applicable.

cached model, and the OEM and Micronics boards accepted only DIPs. Convertible DIP sockets allow some boards, like those from DTK and OEM, to accept either 256K by 4-bit or 256K by 1-bit DRAMs. Except for the OEM 386-25MX, all the boards that we tested could be configured for either 256K or 1-megabit memory devices. Jameco and OEM claim that their boards will support 4-Mb DRAMs when they become available.

SIMMs and SIPs are only slightly more expensive than DIPs and are more convenient to install. But if one chip fails, you must replace the entire SIMM or SIP module rather than one chip. The main attraction of modular memory is for board designers, who exploit their space-saving design to squeeze 8 MB or more of RAM onto an XT-size board.

Adding memory was sometimes problematic. SIP modules on the C² Baby 386 Mainboard were located behind expansion slots and could cause problems if you installed full-length add-in cards. On Jameco's JE3525, SIP modules protruded horizontally from the memory card, blocking the adjacent 16-bit slot (to Jameco's credit, the company doesn't count the blocked slot in its advertisements). Nascent requires that you obtain a new set of programmable array logic chips (PALs) when you're upgrading from 256K parts to 1-Mb parts. (There's a $25 charge for the upgrade, and you have to return the old PALs.) And, most critically, one bank of SIPs on JDR's 386-MB-25S motherboard wouldn't fit under the metal drive bay in our generic AT-size case, effectively limiting the motherboard to 4 MB of on-board RAM.

Getting Compatible

All the motherboards that we tested let you insert wait states to lower the effective speed of the CPU. This may be necessary if you're using older software that doesn't work at 25-MHz CPU speeds. Surprisingly, not all offer the de facto compatibility speed of 8 MHz. Several boards ran at alternate speeds of 10 or 16 MHz; C²'s Baby 386 Mainboard runs at 20 or 25 MHz.

Bus speed was more consistent. All but one of the motherboards ran at or close to 8 MHz, and about half of the motherboards could also run at 10 or 12.5 MHz to support higher-speed add-in cards such as caching hard disk drive controller cards or Ethernet LAN cards. DTK's PEM 2500 Cache 386-25 motherboard didn't offer an 8-MHz bus speed: it ran at 6 or 12 MHz. Unfortunately, if your add-in cards won't run faster than 8 MHz, you will have to run them at 6 MHz—25 percent slower than normal.

System Logic

Some vendors used discrete chips to implement the 386 system logic, and one vendor—Atronics—had its own VLSI chip set. But the majority opted for Chips & Technologies' 386/AT chip set.

continued

A 486 With Zero Wait.

If you've been waiting for the right 486 system to come along, wait no more.

Configured with either the Industry Standard (ISA) bus or the Extended Industry Standard (EISA), CSS Laboratories MaxSys™ systems are the right choice in multi-user file servers.

Compare our features with anybody else's:

- 12 slot motherboard for maximum expandability, longer return on investment
- Systems with 5 or 10 half-height drive bays — enough for the most storage-intensive applications
- 400 watt power supply and two cooling fans for reliable performance under the heaviest workloads
- Proven to run Novell® Netware,™ SCO Xenix,™ ISC Unix,™ IBM® OS/2EE,™ Microsoft® OS/2,™ Quarterdeck® DESQview™
- Exclusive CSS Silent Memory Bus,™ triple-grounded for maximum reliability
- Up to 64 MB RAM*
- On-board support for the Weitek 4167 math co-processor
- Zero wait state cache memory access — plus a special 32-bit Burst Mode memory transfer that outperforms zero wait state in sequential applications
- 25 or 33 MHz available**

With features like these available today, why wait? Call a CSS representative today for more information on the MaxSys line as well as our other product families, including network B&W and color laser printers, desktop workstations, and more.

CSS LABORATORIES, INC.

A Solid Investment.

In the U.S.A. (714) 852-8161
In Canada (416) 882-0260

*64 MB with EISA, 16 MB with ISA.
**33 MHz availability based on Intel chip release.

In the U.S.A.: 1641 McGaw Ave., Irvine, CA 92714. TEL: (714) 852-8161, FAX: (714) 852-9464. In Canada: 60 Mural St., Suite 1, Richmond Hill, Ontario L4B 3H6. TEL: (416) 882-0260, FAX: (416) 881-0461.

Circle 78 on Reader Service Card (DEALERS: 79)

COMPANY INFORMATION

Atronics International
(ATI-386/B)
1830 McCandless Dr.
Milpitas, CA 95035
(408) 942-3344
Inquiry 1074.

C² Micro Systems
(M-386-25, MBI386A+, Baby 386 Mainboard)
1205 Fulton Place
Fremont, CA 94539
(415) 683-8888
Inquiry 1075.

Cache Computers, Inc.
(386-25)
46714 Fremont Blvd.
Fremont, CA 94538
(415) 226-9922
Inquiry 1076.

DTK Computer, Inc.
(PEM 2500 Cache 386-25)
15711 East Valley Blvd.
City of Industry, CA 91744
(818) 333-5429
Inquiry 1077.

Intel Corp.
(Model 302)
3065 Bowers Ave.
Santa Clara, CA 95052
(800) 538-3373
Inquiry 1078.

Jameco Electronics
(JE3525, JE3026)
1355 Shoreway Rd.
Belmont, CA 94002
(415) 595-2664
Inquiry 1079.

JC Information Systems Corp.
(JCS 386c, JCS 386i)
161 Whitney Place
Fremont, CA 94539
(415) 659-8440
Inquiry 1080.

JDR Microdevices
(C386-25, M386-25, 386-MB-25S)
2233 Branham Lane
San Jose, CA 95124
(408) 559-1200
Inquiry 1081.

Micronics Computers, Inc.
(80386-I Cache)
935 Benecia Ave.
Sunnyvale, CA 94086
(800) 234-4386
(408) 732-0940
Inquiry 1082.

Monolithic Systems Corp.
(MicroFrame 386CT)
7050 South Tucson Way
Englewood, CO 80112
(303) 790-7400
Inquiry 1083.

Mylex
(MWS 386-25)
47650 Westinghouse Dr.
Fremont, CA 94539
(415) 683-4600
Inquiry 1084.

Nascent Technology, Inc.
(NT-386-25)
1630 Oakland Rd., Suite A112
San Jose, CA 95131
(408) 441-7500
Inquiry 1085.

OEM, Ltd.
(386-25MX)
75 Kingsland Ave.
Clifton, NJ 07014
(201) 614-7030
Inquiry 1086.

Orchid Technology
(Privilege 386/Cache)
45365 Northport Loop W
Fremont, CA 94538
(415) 683-0300
Inquiry 1087.

Pioneer Computer, Inc.
(VMB-386/25)
49066 Milmont Dr.
Fremont, CA 94538
(415) 623-0808
Inquiry 1088.

Seattle Telecomm and Data, Inc.
(STD 386XT)
2735 152nd Ave. NE
Redmond, WA 98052
(206) 883-8440
Inquiry 1089.

Implemented in seven VLSI chips, the CS8230 chip set lets manufacturers build smaller 386 motherboards with as few as 40 additional chips (excluding memory). By contrast, the Intel Model 302 motherboard, which uses LSI parts for most of its system and cache controller logic, has well over 150 ICs. Chips & Technologies' CS8230 chip sets support page-mode, interleaved memory. Three vendors, JC Information, Cache, and Monolithic, used Chips & Technologies' CS8231 set, which includes the 82C307 cache/memory controller and does not support interleaved memory. Both sets allow shadowing of BIOS ROMs to main memory to speed performance.

AMI's 386 BIOS, installed on 13 motherboards, was the most popular choice among board manufacturers. AMI's BIOS displays the system configuration on boot-up and offers built-in diagnostics and setup screens. Other BIOSes offered most setup options in ROM, but a few required going to a floppy disk for certain tasks, such as setting the CPU speed or running diagnostics. This was particularly true for boards that used older BIOS ROM versions. Some BIOSes also support shadowing of video ROM, which boosts performance for graphics-intensive applications. If you have a preference, most vendors will substitute another BIOS at no extra charge.

Except for C²'s Baby 386 Mainboard, every board supported Intel's 80387. But one board—Seattle's STD 386XT—required a special daughtercard that plugged into the CPU socket. The daughtercard included decode logic to compensate for pipelining problems in earlier 386s. Other boards required setting a jumper to compensate for this problem. But since those earlier chip versions are mostly out of circulation, this wasn't much of an issue.

Most motherboards also supported the 25-MHz Weitek 3167 or 1167 FPU. A few specifically claim to support the Integrated Information Technology IIT-3C87 and Cyrix CX83D87 math coprocessors. But these should work in any FPU socket that supports Intel's 80387. Some motherboards, including the STD 386XT and JDR's 386-MB-25S, have a separate socket that accepts an 8-MHz 80287. C²'s M-386-25 supports the 80387 and a Weitek chip at the same time. Several other motherboards, including the Mylex and Jameco's JE3026, offer an optional daughtercard that offers the same feature. If you need to crunch numbers with software written for both coprocessors, you may want to look into this option.

Expanding Your Horizons

Whether XT or AT size, all motherboards offered either seven or eight expansion slots. The type and usability of the slots, however, varied. Most motherboards had one or two 8-bit slots, four or five 16-bit slots, and one 32-bit slot that also accepted an 8- or 16-bit card. The Cache 386-25 had seven 16-bit slots—the most on any board.

Several products, including two of the JDR Microdevices boards and the Seattle STD 386XT board, had three 8-bit slots. None of the motherboards exhibited any bus compatibility problems during our tests. But some slots weren't optimally designed. For example, ROMs positioned just behind the two 8-bit slots in JDR Microdevices' C386-25 prevented them from accepting some 8-bit cards or some video boards designed to fit in either 8- or 16-bit slots.

Fit and Finish

All the motherboards appear to be designed well. A few have one or two wire

continued

You don't have to be a rocket scientist to program in BASIC.

Granted, with Microsoft's BASIC Professional Development System, rocket scientists can work wonders every day of the week.

But if you want to work better in this stratosphere, Microsoft® QuickBASIC is all you need.

Instead of an I.Q. test, you get a step-by-step printed tutorial that guides you through a complete working program. And our handy on-line electronic manual lets you put your finger on anything you want to know instantly, or copy and paste sample code into your program window.

Meanwhile, our on-line training and Easy Menus make you feel at home in your new environment in minutes—not hours. And to simplify things even more, our intuitive interface offers context-sensitive help. Plus a debugger that gets your program up and running in record time.

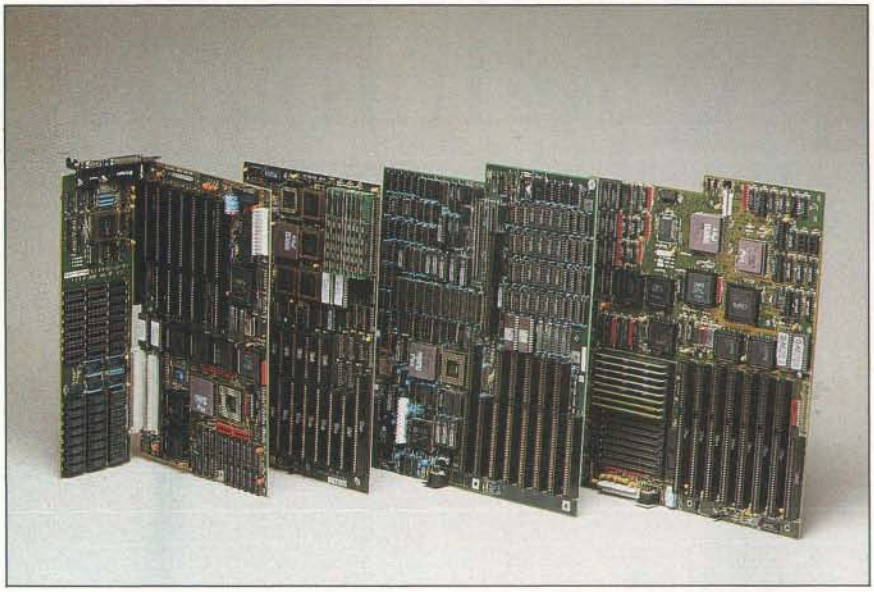
Naturally, this BASIC also turns out code at record speed—150,000 lines per minute.

Not surprisingly, *PC Magazine* called it "...perhaps one of the greatest software programs ever written" and gave it their Editor's Choice Award.

All of which only goes to prove one thing: you don't have to be a rocket scientist to conquer new frontiers.

Just smart enough to get a hold of our Microsoft QuickBASIC.

Microsoft®
Making it all make sense™



Top performers: JC Information Systems' JCS 386c, JDR Microdevices' M386-25, DTK Computer's PEM 2500 Cache 386-25, and Cache Computers' 386-25.

traces. All are logically laid out and are relatively easy to set up and configure. One vendor, Monolithic, mounts its SIP modules between expansion slots on the motherboard, which makes them tough to install or remove—but once they're in, they work just fine. The SIP problem on JDR's 386-MB-25S, on the other hand, is a limitation that we could live without.

The Seattle STD 386XT's FPU setup is also a little awkward. It runs without any problems, but the daughtercard just clears the drive bay housing in our AT case and is an uncomfortably close fit.

Other details are relatively minor. All the boards except the Seattle STD 386XT and C^2's MBI386A+ and M-386-25 offer a connector for a turbo-mode LED, and all the boards have connectors for keyboard lock and hard reset switches and for an external speaker. Many motherboards have a soldered battery for CMOS memory but also include a connector for an external battery as a backup. Two boards—the Atronics and DTK models—have a soldered battery only, but DTK claims a 10-year life for the module. As often as not, vendors with external battery connectors don't include a battery with their motherboard.

Other Considerations

If you're planning to install one of these motherboards yourself, don't count on learning the finer points of assembly from the manuals. Most of the documentation that we received was disappointing. The text often consists of loose, photocopied pages that you are expected to insert into your own three-ring binder. OEM and JDR sent documentation that was written for previous versions of their motherboards. In one case, the motherboard described didn't look anything like the motherboard we received. Other vendors don't document jumper settings or other specifications. Most of the manuals seem unable to keep up with the rapid design changes that are made to these boards.

On the whole, bigger-name manufacturers provide better documentation: Mylex and AMI (via Jameco) provide readable, informative manuals, and Micronics' bound book is especially good. The standout was Intel's Model 302 manual. This 228-page paperback was professionally printed and exhaustive in detail. It included a full description of all specifications, a glossary, an index, and plenty of illustrations. Not even this excellent document, however, is immune to being a few revisions out of step with the product.

If you have trouble with a motherboard and can't find the answers in the manuals, the vendor may have a help line. Some companies, such as JDR Microdevices and Jameco, offer technical assistance over the phone. Others, including Intel and Mylex, refer you to a local dealer or VAR. None of the manufacturers has a toll-free help line.

Most vendors guarantee their motherboards against defects for one year. Unlike the case with fully assembled PC clones, on-site service is not an option. The user must pay shipping costs to the manufacturer. Orchid, Pioneer, and Nascent all offer a two-year warranty, but Monolithic's five-year warranty is the longest offered by far. One vendor, Atronics, will let you extend its warranty from one to two years as an option. As with most nonmechanical devices, failures tend to come early in the product's life, so a one-year warranty is probably sufficient.

First Choice

It's hard to pick one winner from this group. Several boards came out on top in our DOS tests. The Unix benchmark results were consistent with the DOS benchmark results, but the numbers were much closer. The one exception was DTK's PEM 2500 Cache 386-25 with a 256K-byte cache. Moving from 64K bytes to 256K bytes of cache memory didn't make much difference under DOS, but it produced a marked improvement under Unix. Unfortunately, the extra static RAM also makes the board one of the most expensive that we tested.

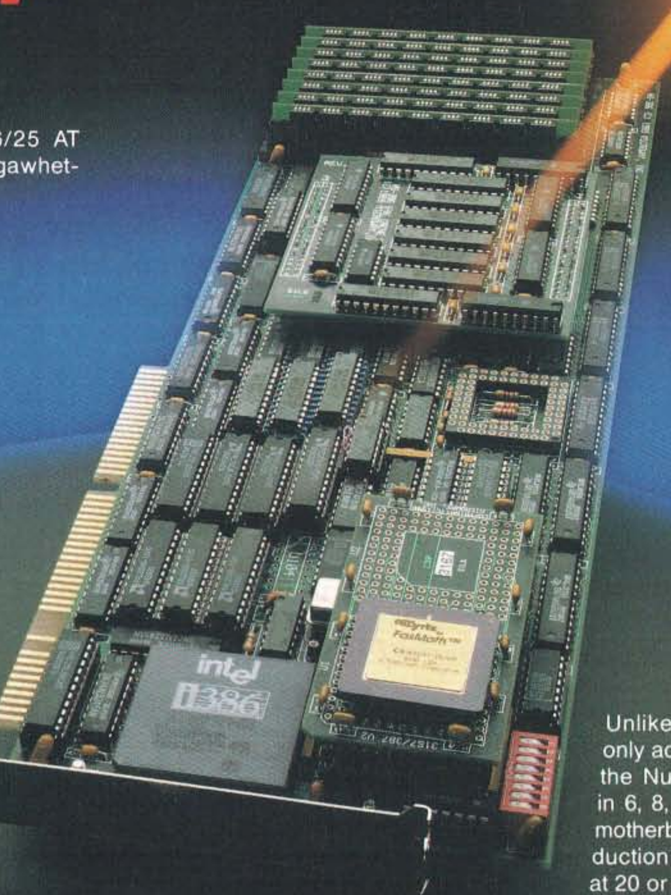
Of the five best-performing motherboards on our DOS benchmark tests (see the photo at left), the JCS 386c and Cache 386-25 offered the most bang for the buck. The Cache, a full-size board, was our favorite overall. It was about as fast as the C^2 M-386-25 and JCS 386c on the CPU test, but it did much better than either on the video tests and had seven 16-bit slots instead of the usual five or six. If you're looking for an XT-size board, the JCS 386c is just $1100 and accepts up to 32 MB of 32-bit memory. The Orchid Privilege 386/Cache and JDR C386-25, the two other top performers, were slightly more expensive.

If $1100 sounds like more than you're willing to spend, consider one of the noncaching boards. JDR Microdevices' XT-size M386-25, the fastest noncaching motherboard that we tested, is $799. The Pioneer VMB-386/25 was on par with the JDR Microdevices M386-25's performance and was slightly less expensive. It was, however, limited to 8 MB of 32-bit RAM. The other noncaching boards had certain drawbacks. The C^2 Baby 386 Mainboard ran its FPU at 20 MHz instead of 25 MHz, JDR Microdevices' 386-MB-25S wouldn't fit into our AT case with all its SIP sockets filled, and the Seattle STD 386XT board was relatively slow and expensive. ■

Steve Apiki and Stan Wszola are testing editors for the BYTE Lab. Rob Mitchell is a BYTE technical editor. They can be reached on BIX as "apiki," "stan," and "rob_mitchell," respectively.

FasMath Your 386!

Running in our Number Smasher-386/25 AT accelerator, the FasMath delivers 5.5 megawhetstones of numeric throughput.



Unlike the Inboard, which only accelerates 8 MHz ATs, the Number Smasher runs in 6, 8, 10 and 12 MHz 286 motherboards! Standard production is currently available at 20 or 25 MHz, with a list of options that include sockets for up to 8 megabytes of 32 bit RAM, Intel, Cyrix and Weitek Coprocessors, a 64 Kbyte Cache and interface cables for any of the 3 possible 80286 sockets. Running at 25 MHz with the CX83D87, the number Smasher generates 3.7 Megawhetstones, which is a factor of 30 improvement over an 80287 running in an 8 MHz AT.

CYRIX CX83D87 FasMath™ Coprocessor

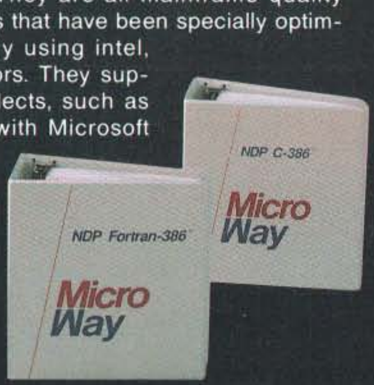
This new numerics coprocessor from Cyrix Corporation is a high performance CMOS 80387 compatible device. Its features include a 91 bit wide architecture that results in improved speed and accuracy and an idle cutoff that reduces power consumption, making it ideal for laptops. Long running operations such as square root, division, transcendentals, exponents and logs run between 2 and 4 times as fast as identical functions on an 80387. The improved accuracy results in faster convergence when used with error sensitive routines. Driven by NDP Fortran-386, the FasMath delivers 3.72 Megawhetstones at 25 MHz and 5.05 Megawhetstones at 33 MHz.

Number Smasher 386/25™

The new Number Smasher is the fastest PC accelerator brought to market to date. It replaces the 80286 in any AT or compatible with an 80386 running as an asynchronous emulator (see BYTE "PC Accelerators" Nov. 1986 Stephen Fried).

NDP 386 Compilers

MicroWay's NDP Fortran, C and Pascal are available in 386, 386SX and 486 versions. They are all mainframe quality globally optimizing compliers that have been specially optimized for the 386/486 family using intel, Cyrix or Weitek coprocessors. They support the most common dialects, such as UNIX System V or ANSI C with Microsoft extensions, Fortran 77 with VAX VMS extensions, and ISO Pascal. All include the MicroWay GREX graphics library and run under UNIX, XENIX and the popular 386 DOS Extenders.



Cyrix, FasMath, and CX83D87 are trademarks of Cyrix Corp., MicroWay and Number Smasher are registered trademarks of MicroWay, Inc., 80386, 80387, 80486 are trademarks of Intel Corp.

MicroWay

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, UK., 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

More Box For The Buck.

DTK 386 systems deliver superior performance at prices that are hard to beat.

33MHz. Take our KEEN-3300 Series for example. Its innovative high speed write-back cache memory and 80386-33 microprocessor combine to deliver zero wait state performance and a MIPS rating of 8.2.

***PC Magazine* said: "The excellent processor performance and expansion capability of the KEEN-3304 make it a very good network file server."**

Key Features	KEEN-3300 Series	KEEN-2500 Series	KEEN-2000 Series	PEER-1630 Series
Processor	80386-33	80386-25	80386-20	80386SX-16
Configurations				
Tower Model	KEEN-3304	KEEN-2503	KEEN-2000T	—
Desktop Model	KEEN-3302	KEEN-2500	KEEN-2000D	PEER-1632
Mini-AT Model	—	—	—	PEER-1630
DRAM on Motherboard	Up to 8MB	Up to 8MB	Up to 1MB	Up to 5MB
32-bit DRAM (max.)	16MB	16MB	17MB	5MB
Cache Memory	64/256KB	64/256KB	—	—
Landmark Rating	59MHz	44MHz	27MHz	20MHz

25MHz. The KEEN-2500 Series has the same lightning fast cache memory scheme as the 33MHz and delivers 6.2 MIPS. It's Novell Certified for use with NetWare, and XXCAL Labs certified for compatibility with a long list of hardware, operating systems and, of course, the latest high-performance software.

***Personal Workstation* said: "The caching strategy and overall cache and board design undoubtedly affect system performance, boosting the DTK (KEEN-2500) to one of our top performers... one of the best high-performance bargains we've seen."**

20 and 16MHz. DTK also offers you a choice of dependable, top-performing 20MHz 386 and 16MHz 386SX models. They're among the fastest and most flexible systems in their class.

All systems are backed with DTK's one year parts and labor warranty.

So when you're looking for a top-rated 386 with "take it to the bank" dependability and savings to match, look to DTK.

Call or write DTK Computer Inc., 15711 E. Valley Blvd., City of Industry, CA 91744. Tel: (818) 333-7533 Fax: (818) 333-5429 BBS: (818) 333-6548

Branch Offices:

City of Industry, CA (818) 333-7533
Miami, FL (305) 477-7440
Elk Grove Village, IL (708) 593-3080
Edison, NJ (201) 417-0300
Houston, TX (713) 568-6688

dtk®

Clearly superior.

DTK, Intel 386, Novell, NetWare and XXCAL are registered trademarks of Datatech Enterprises Co. Ltd.; Intel Corporation; Novell, Inc. and XXCAL, Inc. respectively.

Circle 101 on Reader Service Card (DEALERS: 102)

Color Hits the Streets

NEC's pioneering ProSpeed CSX brings color to portables for the first time, but at a steep price

Mark L. Van Name and Bill Catchings

Last October, NEC delivered its ProSpeed CSX, the first commercially available laptop with a color liquid crystal diode (LCD) display. Although it's nice to see a color laptop, the CSX's price and display quality leave much to be desired.

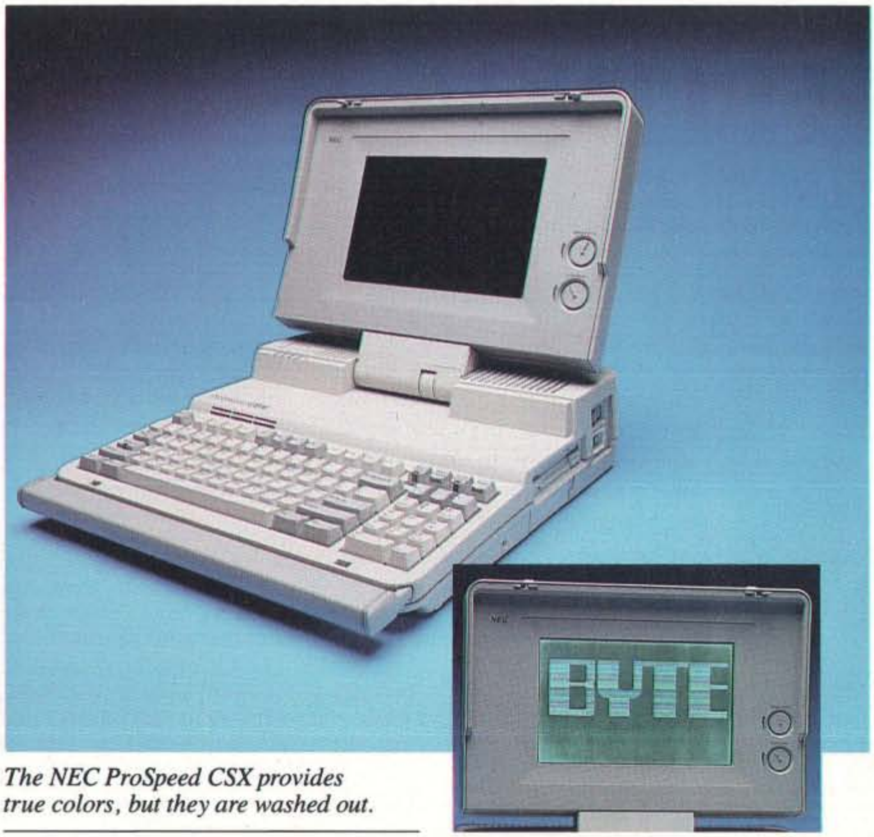
Our evaluation unit was a standard ProSpeed CSX, with a 16-MHz 386SX, a socket for a 16-MHz 80387SX math coprocessor, 2 megabytes of memory, a 42-MB hard disk drive, a 3½-inch 1.44-MB floppy disk drive, one serial and one parallel port, an external floppy disk drive connector, an external VGA monitor connector, and an 8-color VGA LCD screen with 256K bytes of video RAM. The CSX requires AC power. Bundled with the system were MS-DOS 3.3, GW-BASIC 3.3, and Windows/386 2.1.

This package costs a hefty $8499. You can also get a model with a 100-MB ESDI hard disk drive for $9499.

The Wide World of Color

At these prices, you really have to want color. The system's display supports all EGA options but only some VGA display models. In VGA text mode, you get a full 25-row by 80-character display. The CSX's 640- by 400-pixel resolution,

continued



The NEC ProSpeed CSX provides true colors, but they are washed out.

NEC ProSpeed CSX

Company
NEC Technologies, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(800) 632-4636
(508) 264-8000

Components
Processor: 16-MHz Intel 386SX; socket for 16-MHz Intel 80387SX math coprocessor
Memory: 2 MB of 80-ns DRAM in 1-megabit SIMMs, expandable to 4 MB; 128K bytes of BIOS ROM
Mass storage: 3½-inch 1.44-MB floppy disk drive; 42-MB 28-ms modified-frequency-modulation hard disk drive
Display: Color, 9¾-inch, cold cathode fluorescent tube, backlit, compensated twisted nematic LCD internal display with direct matrix addressing
Keyboard: 89-key, with modified separate numeric keypad embedded
I/O interfaces: One 9-pin serial port; one 25-pin parallel port; two proprietary expansion slots

Price
Base system: $8499

Inquiry 852.

The color screen costs you a great many things. Two immediately obvious costs are the system's size and power requirements.

however, hurts you on VGA graphics, where you lose 80 pixels off the bottom of the display. You also get only 8 colors, although 16 colors are available on an external monitor, courtesy of a Chips & Technologies 82C455 flat-panel video controller.

The image quality of the LCD display isn't great. The colors are true, but they are washed out. Large areas of the same color tend to be mottled, and the screen bleeds when it scrolls. You can lose a mouse if you move it too quickly, as NEC warns you in a product release bulletin. The screen ghosts vertically a great deal.

Also, while we were testing the system, two vertical lines (one green and one red) appeared on the left side of the screen. They eventually vanished, but not immediately and not when we initially turned off the machine. An NEC spokesperson had not heard of this problem but was not surprised by it. (For more details on the display, see the text box "Competing Color LCD Display Technologies" on page 148.)

The Cost of Color

The color screen also costs you a great many things. Two immediately obvious costs are the system's size and power requirements. It's larger than most laptops by an inch or two in all dimensions, thanks primarily to the thick display and the 70-watt power supply necessary to support the color screen.

Another obvious cost is money. The CSX runs $1904 more than NEC's own monochrome $6995 lunchbox PowerMate SX. Worse, a comparable Dell System 316LT monochrome 386SX portable, which can run off batteries, costs $3999—$4500 less than the CSX. To be fair, the CSX will probably have a street price well below its list, while the Dell will not, but the price difference between the two systems is still likely to be large.

You also pay a performance premium, because the CSX's display is slow. The CSX was nearly three times slower on the BYTE video benchmarks than the desktop IBM PS/2 Model 55 SX, a reasonable but not particularly fast 386SX system. The CSX's anemic video performance also hurt the system's overall application index, which was about 8 percent below the Model 55's. That's too bad, because the CSX performed reasonably well in other areas, including the CPU and hard disk drive tests, where it beat the Model 55 by 11 percent and 15 percent, respectively.

Spotless Compatibility, Good Keyboard

You may give up performance with the CSX, but you lose nothing in compatibility. The system successfully ran all our test programs, including Borland's Paradox/386 2.03, Quattro 1.0, SideKick Plus 1.00A, SuperKey 1.16A, Turbo C 2.0, and Turbo Pascal 4.0; Digitalk's Smalltalk/V 1.2; Foresight's Drafix CAD Ultra 3.03C; Lotus 1-2-3 release 2.2; MicroPro's WordStar 4.0; Microsoft's Windows/386 2.11 and Word 4.0; Novell's NetWare 2.15; the Norton Utilities 3.00; the public domain Kermit 2.32/A; Quarterdeck Office Systems' DESQview 2.00 and QEMM-386 1.10; Symantec's Q&A 1.1; and WordPerfect 5.0. The CSX also worked with our test hardware, which included a Microsoft Serial Mouse and an external Xircom Pocket Ethernet Adapter.

You also sacrifice little with the ProSpeed CSX's keyboard, which has a good feel and 89 full-size keys, including a modified separate numeric keypad. The keyboard basically follows the AT Enhanced keyboard layout, minus the central arrow and cursor-position clumps, and with two keys (/ and Enter) missing from the numeric keypad.

Going Inside

Open the CSX, and the first thing you notice is its power supply, a collection of analog parts and circuits that spans the rear of the machine. There's also a fan, one of the few we've seen in a clamshell portable.

The disk drives sit in front of the power supply—the hard disk drive on the left, and the floppy disk drive on the right. The 3½-inch NEC hard disk drive has a 28-millisecond average access time. It runs off a National Computer ST506 controller that sits on a small

continued

NEC ProSpeed CSX

APPLICATION-LEVEL PERFORMANCE

NEC ProSpeed CSX **8.8***

WORD PROCESSING	
XyWrite III + 3.52	**Medium/Large**
Load (large)	:12
Word count	:04/:28
Search/replace	:07/:28
End of document	:02/:17
Block move	:10/:10
Spelling check	:11/1:24
Microsoft Word 4.0	
Forward delete	:19
Aldus PageMaker 1.0a	
Load document	:12
Change/bold	:33
Align right	:28
Cut 10 pages	:22
Place graphic	:06
Print to file	2:18
Index:	**2.11**

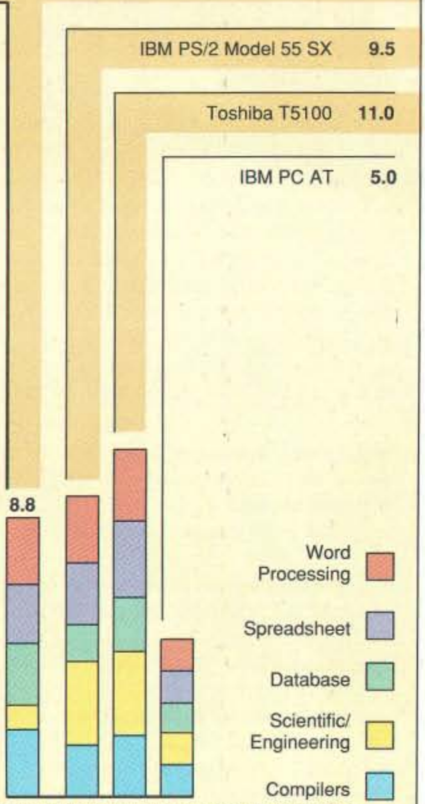
SPREADSHEET	
Lotus 1-2-3 2.01	
Block copy	:04
Recalc	:02
Load Monte Carlo	N/A
Recalc Monte Carlo	N/A
Load rlarge3	:05
Recalc rlarge3	:02
Recalc Goal-seek	:05
Microsoft Excel 2.0	
Fill right	:07
Undo fill	2:38
Recalc	:02
Load rlarge3	:30
Recalc rlarge3	:02
Index:	**1.89**

DATABASE	
dBASE III + 1.1	
Copy	:26
Index	:08
List	2:43
Append	2:12
Delete	:03
Pack	1:28
Count	:05
Sort	:55
Index:	**1.96**

SCIENTIFIC/ENGINEERING	
AutoCAD 2.52	
Load SoftWest	2:42
Regen SoftWest	2:30
Load StPauls	:46
Regen StPauls	:42
Hide/redraw	36:16
STATA 1.5	
Graphics	1:43
ANOVA	:55
MathCAD 2.0	
IFS 800 pts.	1:29
FFT/IFFT 1024 pts.	1:45
Index:	**0.78**

COMPILERS	
Microsoft C 5.0	
XLisp compile	4:56
Turbo Pascal 4.0	
Pascal S compile	:05
Index:	**2.09**

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT=1.



*Cumulative application index. Graphs are based on indexes at left and show relative performance.

LOW-LEVEL PERFORMANCE[1]

NEC ProSpeed CSX

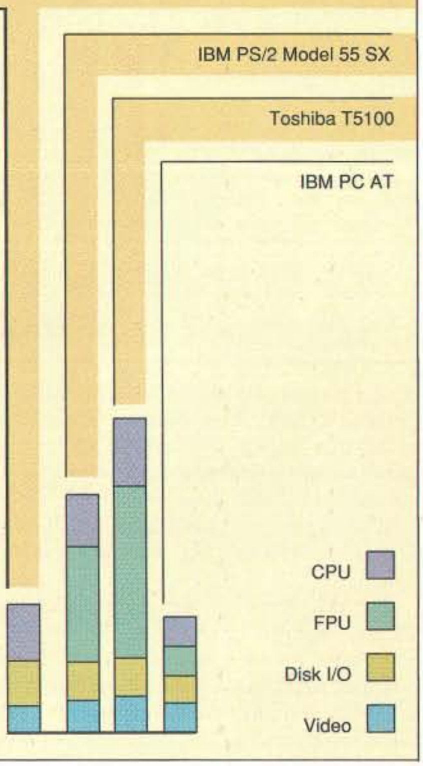
CPU	
Matrix	7.07
String Move	
Byte-wide	41.54
Word-wide:	
Odd-bnd.	43.26
Even-bnd.	20.78
Doubleword-wide:	
Odd-bnd.	29.42
Even-bnd.	19.06
Sieve	36.36
Sort	32.33
Index:	**1.98**

FLOATING POINT[2]	
Math	N/A
Error	
Sine(x)	N/A
Error	
e^x	N/A
Error	
Index:	**N/A**

DISK I/O	
Hard Seek[3]	
Outer track	3.30
Inner track	3.28
Half platter	6.72
Full platter	10.00
Average	5.83
DOS Seek	
1-sector	13.93
32-sector	35.09
File I/O[4]	
Seek	0.21
Read	0.83
Write	0.92
1-megabyte	
Write	5.47
Read	3.66
Index:	**1.57**

VIDEO	
Text	
Mode 0	17.03
Mode 1	17.03
Mode 2	17.41
Mode 3	17.41
Mode 7	N/A
Graphics	
CGA:	
Mode 4	2.58
Mode 5	2.58
Mode 6	2.86
EGA:	
Mode 13	4.88
Mode 14	5.55
Mode 15	N/A
Mode 16	5.54
VGA:	
Mode 18	5.77
Mode 19	2.80
Hercules	N/A
Index:	**0.92**

CONVENTIONAL BENCHMARKS	
LINPACK	2918.41
Livermore Loops[5] (MFLOPS)	0.01
Dhrystone (MS C 5.0) (Dhry./sec.)	3612



N/A = Not applicable.

[1] All times are in seconds. Figures were generated using the 8088/8086 and 80386 versions (1.1) of Small-C.

[2] The errors for Floating Point indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

[3] Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

[4] Read and write times for File I/O are in seconds per 64K bytes.

[5] For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June 1988 BYTE.

Competing Color LCD Display Technologies

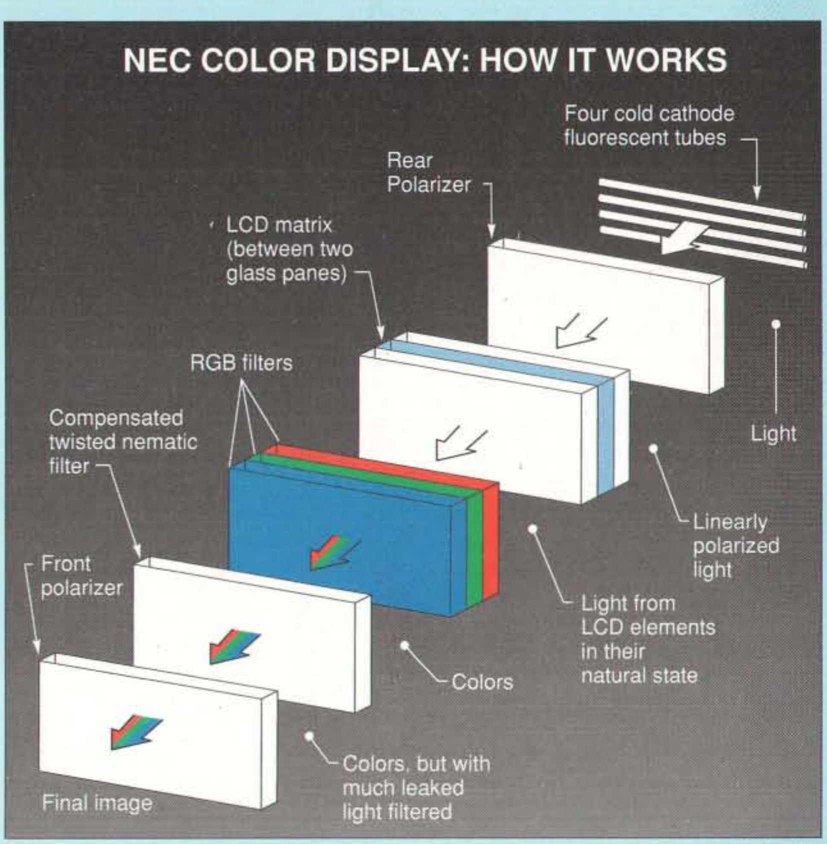
There are currently two major basic color liquid crystal diode (LCD) display technologies. NEC's ProSpeed CSX uses a technique known as direct (or passive) matrix addressing. The competing approach is called indirect (or active) matrix addressing or, sometimes, thin film transistor (TFT). (We will explain these terms below.)

These two color LCD display technologies have much in common, as well as a few key differences. The easiest way to understand them is to follow the light through the many layers that both types of displays typically contain (see the figure).

The rearmost layer is the light source. In the CSX, four cold cathode fluorescent tubes provide the display's backlighting.

Directly in front of the light source is the rear polarizer, which lets through only light that is oriented perpendicularly to the LCD display's crystals. This linearly polarized light passes to the third layer, a sandwich with two panes of glass surrounding a matrix of LCDs. In their natural, twisted state, these LCD elements pass through the polarized light. If you apply current to them, however, they straighten and block the light. The LCD sandwich contains three elements for every screen pixel.

Follow the bouncing light rays. From its original source, the light passes through a rear polarizer, which allows properly oriented light to pass to the LCDs. The LCDs react to the light, blocking some of it. What passes goes to the RGB polarizer, which has red, green, and blue filters that combine to form one of the eight available colors. Another layer blocks "leaked" light, and the remaining light passes through a final polarizing layer and to the viewer.



daughtercard between the hard and floppy disk drives. This design, while unusual in a laptop, makes it easy to upgrade to the ESDI controller of the CSX's optional 100-MB hard disk drive. The NEC floppy disk drive uses a Western Digital controller chip on the motherboard.

There's plenty of room for that chip on the motherboard, which is the biggest (by about an inch in depth) and most crowded motherboard we've ever seen in a 386SX system, desktop or laptop. Not counting memory, the motherboard has over 100 chips, including two Zymos POACH (for "PC on a Chip") application-specific ICs.

The ProSpeed CSX's standard 2 MB of 80-nanosecond DRAM are soldered to the motherboard in 1-megabit single inline memory modules. The system uses a paged/interleaved architecture to avoid wait states most of the time.

The 386SX CPU and the socket for the 80387SX are on a small card under an expansion area cover on the bottom front of the machine—a nice touch that makes it easy to add a math coprocessor. Also under that expansion cover are two proprietary expansion slots, one for a 2400-bps modem and one for an additional 2 MB of DRAM.

Odds and Sods

It's almost easier to add those expansion options than it is to set up the machine. First, you must run the Setup program to make sure that the system's CMOS accurately reflects its configuration. Then you must do a high-level disk format, and, finally, you install DOS. Fortunately, both the Setup program and the system's documentation are good, so this process isn't hard.

If you do run into problems, the CSX

The next layer, the RGB polarizer, houses one filter for every LCD element. Each screen pixel gets one red, one green, and one blue filter for its three LCD elements. By using all possible combinations of these three filters, you get the eight colors possible with the CSX: black, white, red, green, blue, cyan, magenta, and yellow.

You could produce 16 colors by using a fourth LCD element for each screen pixel. The filter in front of that element would be white and would function much like the intensity signal of some color monitors.

LCD displays tend to "leak" some of the light they're trying to block, so the CSX next uses a compensated twisted nematic layer that removes much of the leaked light. Finally, the light passes through another polarizing layer and then out to the viewer.

This design has a problem: Much as dots on CRT screens fade after they are activated, LCD elements relax and begin to lose intensity after they are charged. Direct and indirect addressing displays deal with this problem differently.

In direct matrix addressing, the driver circuit connects directly to each LCD element. The driver circuit then addresses one row of LCD elements at a time, in sequence from top to bottom on the screen (much as the electron gun scans a CRT screen). Unfortunately, as soon as the driver circuit leaves a row, that row's LCD elements begin to relax to their inactivated state. The result is bleeding, or ghosting, as well as a lower contrast ratio.

Indirect matrix addressing produces better images and avoids most of the ghosting by keeping current supplied to every LCD element. To do so, it inserts a memory transistor between the driver circuit and each LCD element. The driver connects only to the transistors (hence the "indirect" in the name), which supply the LCD elements with current while the driver scans the display.

Active matrix sounds so much better that you have to wonder why NEC didn't use it in the CSX. The reason is cost.

An active-matrix display requires one transistor per element. To get eight colors and the full VGA 640- by 480-pixel resolution, it would need at least 640 by 480 by 3 (3 pixels per element) transistors—that's 921,600 transistors in a continuous, thin 10-inch layer. (That's the source of the "thin-film transistor" name.) No one can yet mass-produce such a dense screen with high enough yields to make the manufacturing process cost-effective. An NEC spokesperson estimated that a TFT display today would cost buyers at least $2000 more than the CSX's already expensive display.

These technologies also require much more power than monochrome LCD displays need. In part because of the many filters, the color panel transmits only about 20 percent to 25 percent as much light as a typical paper-white LCD display would. The many transistors of a TFT display demand even more power.

Both technologies are, at least for now, considerably more expensive to produce than standard monochrome LCD displays. We must hope that future developments will make good color LCDs affordable.

comes with a one-year parts-and-labor warranty. While NEC normally directs repair requests to its dealers, the CSX is so new that few dealers will have such crucial spare parts as extra displays; consequently, for now, you must ship the CSX to NEC for repairs.

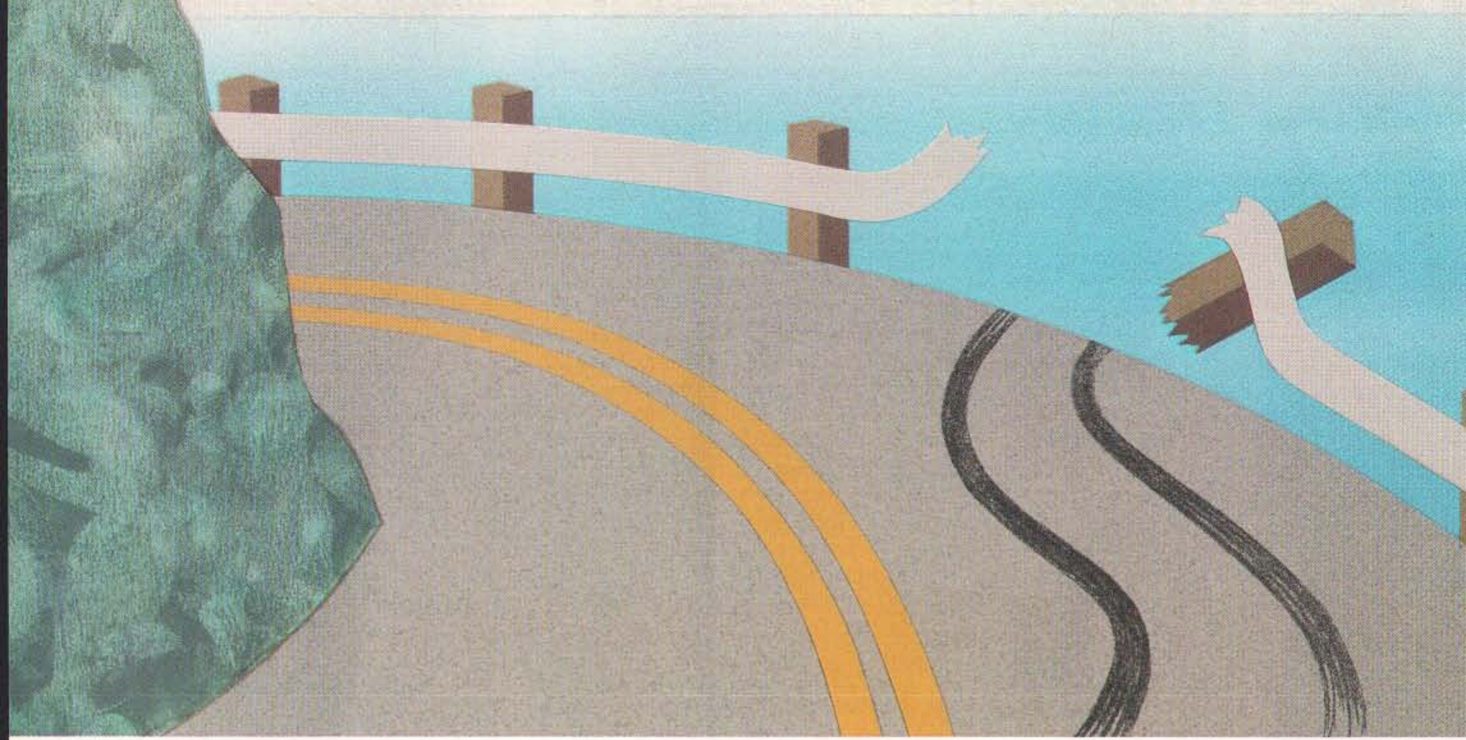
Your NEC dealer remains your first line of technical support. You can also call NEC technical support if you are unhappy with your dealer's support.

The Color of Money

Some machines are hard to peg, but the NEC ProSpeed CSX isn't one of them. At least for now, it's the only color laptop around.

If you've absolutely got to have a color laptop, go for the NEC ProSpeed CSX. Otherwise, you should wait for the day when color laptop technology matures enough to give us vibrant, quick displays at reasonable prices. ■

Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.



Just Being Fast Isn't Good Enough...

Micronics 25 MHz and 33 MHz motherboards allow you to maneuver in the 386 fast lane!

Some manufacturers push components and designs to improve performance and reduce their costs. Pushing components, even a little bit, creates the kind of heat and stress that cause systems to crash and data to be lost forever.

Micronics refuses to give in to this practice. We recognize there is nothing more valuable than your data. Our motherboards are designed and manufactured with the kind of reliability demanded by todays' high performance computers. These computers require devices such as: cache memory, fast static RAM and coprocessors originally used only in mainframes. Advanced operating systems including UNIX and OS/2 require high levels of design sophistication. Large databases, spreadsheets and multiuser applications also have complex critical timing requirements. Micronics motherboards are built to meet these needs.

Advanced engineering, high quality, and unequalled reliability: motherboards created by Micronics to help keep you in the 386 fast lane!

Call now for more information and the Micronics supplier nearest you.

National WATS
(800) 234-4386
California
(408) 732-0940
FAX
(408) 732-6048

MICRONICS
COMPUTERS INC.

Fully Utilizing the Power of the 386.

935 Benecia Avenue, Sunnyvale, California 94086

386 is a trademark of Intel Corp.

Circle 186 on Reader Service Card

Svelte Scanner Is No Fistful of Dollars

Sharp's low-cost scanner delivers high-quality color images to those who can afford to wait

Tom Thompson

The Sharp Electronics Personal Color Scanner's svelte size gives the impression that it's a hand-held scanner. It's not. It's a diminutive (6⅓ by 12⅔ by 1⅔ inches) flatbed scanner about the size of an add-in board's carton, and its weight is equally modest at just over 3½ pounds. There is a serial interface for communicating with a computer, so no interface boards are required to connect it to a Mac II, a PC, or an Amiga.

The $995 JX-100 produces high-quality images at several resolutions and in a variety of modes (black and white, gray scale, and color). But this convenience has a price. Because of its small size, the scanner handles only small images, and color scanning can be time-consuming.

A Hardware Tour

The JX-100 is a stationary flatbed scanner, unlike its much larger cousin, the JX-450, whose bed moves from side to side. Transparent panels make up most of the JX-100's top and bottom. A white rectangle on the bottom panel delineates the scanning area. Original images must be no greater than 3.93 by 6.29 inches; thus, the scanner is suitable for typical 4- by 5-inch snapshot prints.

A compact scanning head with a sensor strip travels inside the transparent panels to acquire image data. For color images, the scanning head must make three passes over an original, which explains why color scanning can take so long (see the text box "Inside the Personal Scanner" on page 152).

To hook the scanner to a Mac, you'll need the DB-9-to-mini-DIN-8 adapter cable supplied with the Mac scanning software. The scanner's serial cable ends in a DB-9 serial connector for an IBM AT. The scanner works with a PC, a Mac II, or an Amiga, but only the Macintosh software was available as of press time.

Power comes from a 12-volt power-supply brick. An adapter cable from this brick plugs into a special connector on the serial cable. The scanner has no on/off switch; you handle that detail by plugging in or unplugging the power supply.

Scanning Software

The JX-100 handles Mac II scanning with Imagenesis's ChromaScan 100 application software, a modified version of the Sharp JX-450 scanner application. ChromaScan requires 32-Bit QuickDraw, so you can use the software and scanner only on the Mac SE/30 or Mac II-family computers. ChromaScan saves the captured image data in memory, so your Mac needs at least 4 megabytes of RAM; Imagenesis recommends 8 MB.

ChromaScan lets you scan an image in black and white with a user-selectable threshold (a brightness value that determines whether a pixel is white or black). You can also do color scans either as indexed colors (256 colors maximum, using a byte value that corresponds to a color table entry) or as direct colors (the pixel holds the actual color data and can be 16 or 32 bits in size). Indexed colors can be based on the default system color table or on a custom color table sorted by ChromaScan for the best-fit 256 colors. While direct color scans can display more colors, they also take up more memory and more disk space. All captured images are saved in the Mac's PICT2 format, which allows other applications to use them.

ChromaScan's preview mode makes a fast gray-scale scan of the original and then presents it in a special preview window. Here you can drag slider bars over

continued

Sharp JX-100 Personal Color Scanner

Company
Sharp Electronics Corp.
Systems Division
Sharp Plaza
Mahwah, NJ 07430
(201) 529-9500

Hardware Needed
Mac SE/30 or Mac II-family computer with at least 4 MB of RAM and a hard disk drive (SE/30s must have a color monitor set up as the main screen); versions for the IBM AT and Commodore Amiga are planned

Software Needed
System 6.0.3 or higher with 32-Bit QuickDraw

Price
$995

Inquiry 851.

the window to choose what part of the image you want to scan in detail. A Mode window lets you select the resolution (50, 100, or 200 dots per inch, or user-selectable), type of scan (indexed or direct color, gray scale, or black and white), and dithering. A Tone Control window lets you fine-tune the brightness, contrast, and color balance of the incoming data. Once you've adjusted the settings to your satisfaction, you start the scan via keyboard command, by menu selection, or by clicking on a Scan button.

When the JX-100 completes its scan, a window displays the captured image. You can save the image to a file or print it. ChromaScan allows multiple open windows (as much as memory allows) and even opens previously scanned files. However, there are no editing tools for tinkering with the image, and all the tone-control settings apply only to the scan in progress.

Field Test

I put the JX-100 scanner to work on a variety of snapshots, magazine covers, and photos from books. I used a Mac II running System 6.0.3 and equipped with 5 MB of RAM, a Rodime Cobra 210e 210-MB hard disk drive, and a SuperMac 19-inch monitor and Spectrum/8 video board. Installation takes only about 3 minutes: You plug the serial cable into the Mac's modem port, plug in the scanner's power supply, and copy the software to the Cobra drive.

The scanner's viewfinder and ChromaScan's preview window made scanning a snap. I selected what I wanted to scan and what type of scan with just a few mouse-clicks. Previews took only a minute, and 100-dpi gray-scale scans took 2 minutes, 10 seconds. The quality of the color images was excellent, even at 200 dpi. I hadn't expected such quality in the

continued

Inside the Personal Scanner

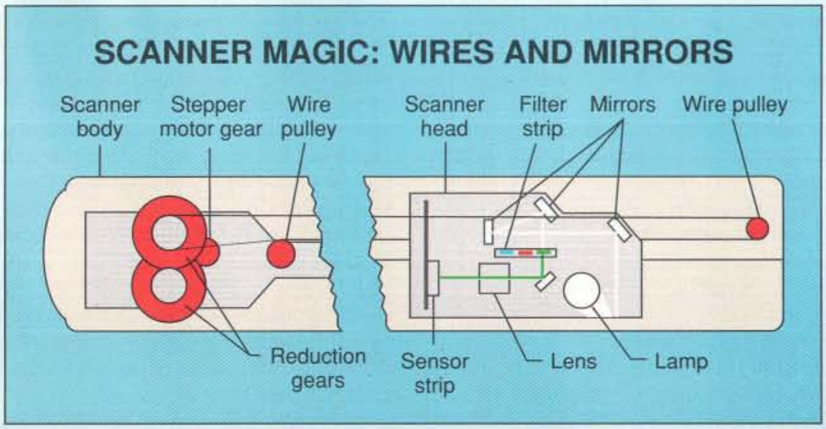
How did Sharp cram so many capabilities into such a small unit as the JX-100? The scanner's compact size and weight result from a combination of tiny components and a clever design that builds on techniques used in Sharp's JX-450 color scanner.

However, the JX-450 acquires an image by moving its bed from side to side, which moves the original over a stationary sensor strip built into the housing (see "Full-Spectrum Scanners," April 1989 BYTE). By contrast, the JX-100 lies atop the original image and remains stationary during the capture process. Inside the JX-100's housing, a scanner head rides on two rails. A precision stepper motor drives a wire pulley that moves the head in precise steps across the image. As the scanner head travels from one end of the housing to the other, a sensor strip inside it captures the image a line at a time (see the figure).

A minuscule fluorescent lamp inside the scanner head illuminates the image. Four mirrors route light reflected from the image through color filters and a lens and then onto a charge-coupled-device sensor strip with 1024 elements. Each element samples the light intensity that corresponds to a spot on the image. While each element can detect 256 different light levels, the accuracy of the sample is good only to 6 bits.

The scanner head samples monochrome image data. With the use of color filters, color scans are possible. The original is scanned three times to collect red, green, and blue information. A clever lever mechanism switches a filter strip inside the scanner head from one color to the next. Each time the scanner head returns to start a new scan, a shaft engages a projection inside the housing that advances the filter strip to the next color.

Inside the Mac, software combines the data from each scan into a color image. For indexed color images, the information is reduced to the 256 best-fit colors. For direct color images, the information is assembled into pixels. For 16-bit scans, a pixel contains 15 bits of color information that can represent 32,768 colors. For 32-bit scans, a pixel contains 24 bits of color information that can represent a possible 16.8 million colors. However, since the accuracy of each color pass is limited to 6 bits, the actual number of colors captured by the JX-100 is 262,144. Nevertheless, this range of colors should be adequate for most color desktop publishing work.



To produce a color image, wire pulleys move the JX-100's scanner head over the original three times to sample red, green, and blue information.

Introducing a better way to protect your whole family.

New network savers from Emerson UPS.

However you use your network, a file server power problem can really cost you. In downtime. Lost data. And frustration.

FOR L.A.N.
NOVELL LABS
TESTED AND APPROVED
NetWare Compatible

That's why we've introduced two new Novell-compatible uninterruptible power systems (UPS) designed specifically to protect your file server, your whole network and your data.

They're compact enough to fit under a desk. Powerful enough for a file server or your entire LAN—even those with multiple drives and terminals.

And they're priced less than even one hour of downtime.

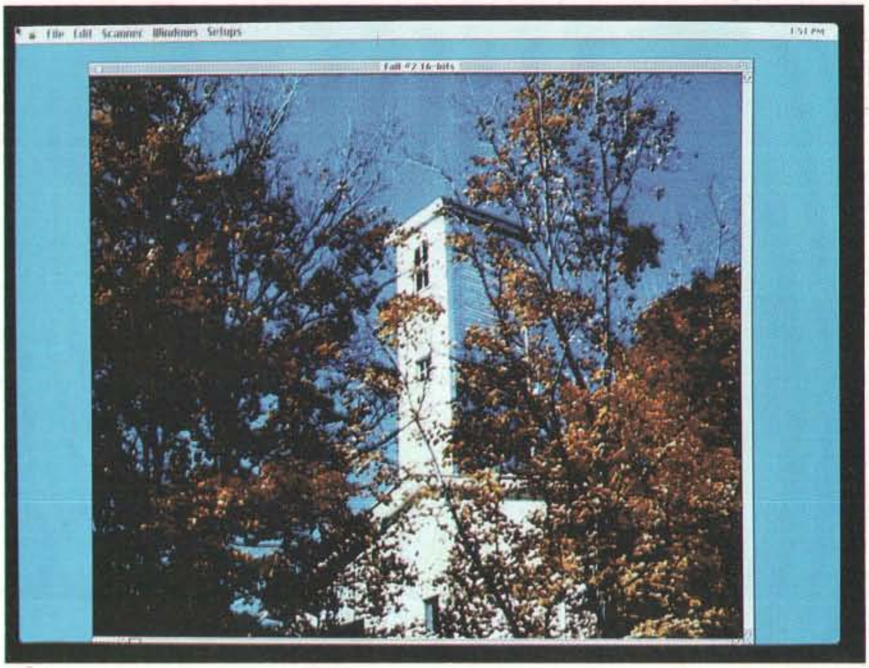
Most important, the UPS 600 and UPS 1250 come from Emerson, the most reliable name in computer power protection. Backed by a network of support from local dealers and distributors. And nationwide service from the leading supplier of UPS systems.

See how easy it can be to protect your whole family. Just call us at 1-800-Back-UPS today.

EMERSON UPS

We protect the ones you love.

Circle 105 on Reader Service Card (DEALERS: 106)



The quality of the JX-100's color images was excellent, even at high resolutions where mechanical misalignment problems can occur.

high-resolution color scans because of the inevitable mechanical misalignment that occurs when the scanner head makes three trips over an image. I saw slight color fringing in the fast scanning mode, but in the slow scanning mode the 100-dpi images were superb.

The scanner always performs 200-dpi imaging in the slow mode, and the quality is as good as that of the 100-dpi scans (see the photo above). PhotoMac 1.1, PixelPaint Professional, and a beta version of PhotoShop easily read 8-, 16-, and 32-bit pixel image files created by ChromaScan. I had no trouble printing images on a Tektronix ColorQuick color inkjet printer. But when I printed to a LaserWriter printer using the color driver (version 6.0), my results were hit-or-miss: Many of the indexed color scans looked good, while direct color scans conked out with a PostScript error before the print job was completed.

The hardware's biggest flaw is the time it takes to scan in color. A 100-dpi dithered scan using the slow mode and indexed colors took nearly 12 minutes to complete. At 200 dpi, the same image took about 35 minutes. The scanning process takes so long because ChromaScan sorts through the image data for the best-fit 256 colors. By contrast, some 16-bit direct color scans at 200 dpi in the slow mode took only 20 minutes.

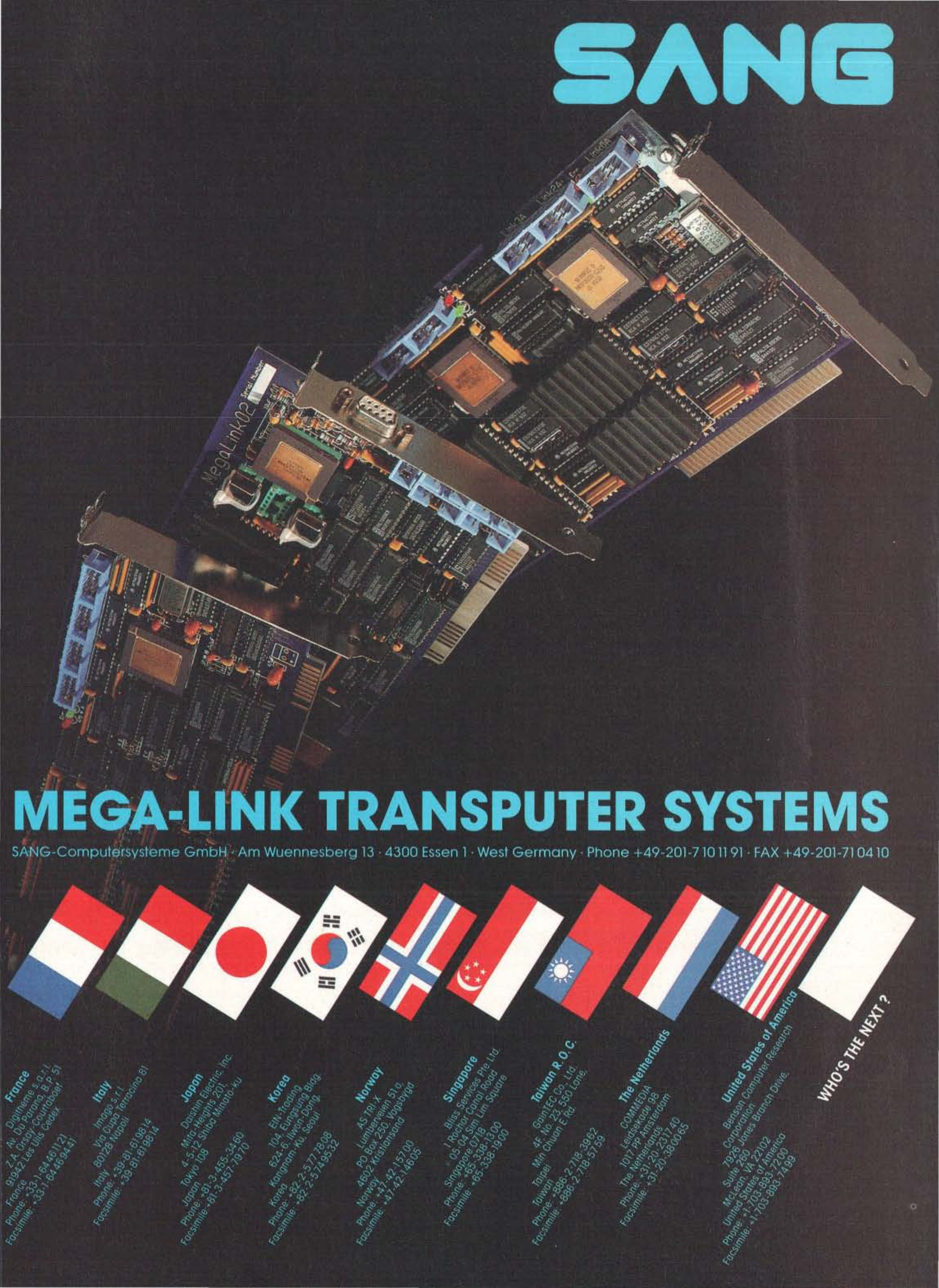
The biggest scanning-software problem is that every color-scan pass is stored in memory. This requires lots of RAM. Even with 5 MB, I often ran out of memory when I tried to make a direct color scan larger than a snapshot. I tried using Connectix's virtual memory INIT to gather more memory, but under virtual memory ChromaScan became erratic, sometimes working, sometimes freezing the system. I'd like ChromaScan to spool each pass to disk during a color scan, to ease up on memory requirements. For now, if you plan to make direct color scans using the scanner's entire imaging area, you'd best have 8 MB of RAM.

Do You Need One?

Make no mistake, the JX-100 works admirably, producing quality color images in the slow mode at the highest resolution. Its low price is attractive, especially for small businesses, and its direct color capabilities will be useful for certain color prepress jobs, as long as the work fits in the scanner's small scanning area.

However, be aware of the trade-offs: You'll need all the RAM you can get, as well as a color graphics package to touch up and print some images. Producing a high-resolution color scan is definitely a start-it-and-leave-for-lunch operation. If you can live with these limitations, then Sharp has a scanner for you. ■

Tom Thompson is a BYTE senior technical editor at large. He can be reached on BIX as "tom_thompson."


SANG
MegaLink02
MEGA-LINK TRANSPUTER SYSTEMS
SANG-Computersysteme GmbH · Am Wuennesberg 13 · 4300 Essen 1 · West Germany · Phone +49-201-7101191 · FAX +49-201-710410
France
Digitheme s.a.r.l.
Z.A. Du Parana, B.P. 51
Av. Orsay Courtaboef
91942 Les Ulis Cedex
France
Phone: +33-1-64461121
Facsimile: +33-1-64469441
Italy
Imago s.r.l.
Via Cupa Terracina 81
80128 Napoli
Italy
Phone: +39-81-619814
Facsimile: +39-81-619814
Japan
Daishin Electric, Inc.
Mita-Heights 201,
4-5-12 Shiba Minato-ku
Tokyo 108
Japan
Phone: +81-3-455-3460
Facsimile: +81-3-457-7970
Korea
EIN Trading
104, Eungsung Bldg.
624-6, Ilwon-Dong,
Kangnam-Ku, Seoul
Korea
Phone: +82-2-577-7808
Facsimile: +82-2-5749532
Norway
AS TRI-X
Lumberveien 51 a,
PO Box 250, Vagsbygd
4602 Kristiansand
Norway
Phone: +47-42-15700
Facsimile: +47-42-14605
Singapore
Bliss Services Pte Ltd
1 Rochor Canal Road
05-04 Sim Lim Square
Singapore 0718
Phone: +65-338-1300
Facsimile: +65-338-1900
Taiwan R.O.C.
GainTEC Co., Ltd.
4F, No. 23, 550 Lane,
Min Chuan E. Rd.
Taipei
Taiwan
Phone: +886-2-718-3962
Facsimile: +886-2-718-5759
The Netherlands
COMMEDIA
Leidsekade 98
1017 PP Amsterdam
The Netherlands
Phone: +31-20-231740
Facsimile: +31-20-380065
United States of America
Benson Computer Research
Corporation
7926 Jones Branch Drive,
Suite 260
McLean, VA 22102
United States of America
Phone: +1-703-893-7200
Facsimile: +1-703-893-7499
WHO'S THE NEXT ?

See the Future.

NANAO fully appreciates the importance of monitor selection to the business professional. The FLEXSCAN® 9060S has been specially designed for today's complex world of windows and graphics applications.

Unlike other 14″ monitors, the FLEXSCAN® 9060S uses its Dynamic Focusing Circuit to deliver sharp, bright images to all corners of the screen. This makes it the ideal display for VGA and SuperVGA (800 × 600) applications.

The FLEXSCAN's ergonomic design minimizes static, glare, and magnetic radiation, to provide the most user-friendly environment possible, even during extended operation.

Other monitors meet the standards.
FLEXSCAN® sets them.

NANAO®

NANAO USA CORP.
23510 Telo Ave., Suite 5
Torrance, CA 90505 USA
Phone (213)325-5202
Fax (213)530-1679

Circle 198 on Reader Service Card (DEALERS: 199)

FLEXSCAN 9060S
14″(13V),0.28mm dot pitch CRT
Scan Frequency : Automatic Adjustment
H: 15.5kHz-38.5kHz
V: 50Hz-90Hz
Front-mounted controls for easy access.
VGA, SuperVGA (800 × 600), EGA, CGA, MDA, and Mac II compatible.

Word Processing in Windows

Amí Professional, Legend, and Word for Windows provide WYSIWYG editing in Microsoft Windows

Lamont Wood

The PC world has long awaited full-featured WYSIWYG word processing software that could also take a swing at desktop publishing. Now, thanks to Microsoft Windows, there are three such packages: Amí Professional 1.0 from Samna, Word for Windows 1.0 from Microsoft, and Legend 2.0 from NBI. Each is priced at $495.

All three offer a wealth of WYSIWYG functionality such as the budget-minded PC user could only have dreamed of a few years ago. But all three packages paid for it—to varying degrees—with performance problems. Printing speeds are particularly troublesome, and in some situations, you have time to get up and make a sandwich while waiting for a page to be drawn on the screen.

I tested the three Windows-based word processors on a 16-MHz Club American 386 with 3 megabytes of RAM, a 30-millisecond hard disk drive, and a Hercules display. I ran them under Windows/386 and printed them on a QuadLaser 1 that emulated a Hewlett-Packard LaserJet.

The Two Worlds

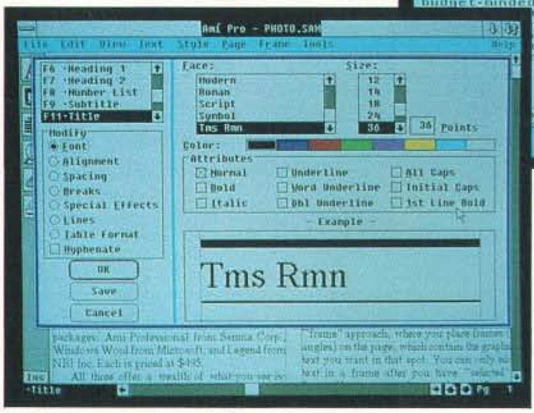
Previously, conventional word processing concentrated on helping you generate text, with spelling checkers, search-and-replace and cut-and-paste functions, and scads of other useful tricks. But any formatting beyond fancy typewriter emulation was not to be expected. Meanwhile, page-layout systems turned your computer into a typesetting machine—but they had no facility for word processing. You were expected to write the material with a word processor and then import it into desktop publishing.

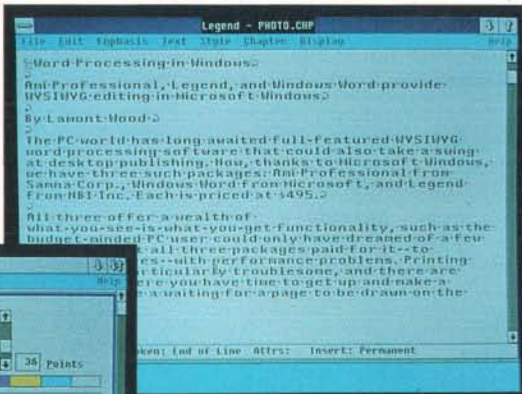
Having both worlds in one package makes sense. The problem is that true WYSIWYG word processing assumes the use of a graphical screen, but composing text on a graphical screen that has to format itself as you type can be a slow and disorienting experience.

These three packages get around the problem by having a draft and a layout mode. You type in draft mode with only text on the screen and switch into layout mode for formatting. (Under many conditions, however, it is possible to type directly into the layout mode. For eye relief, I often edited raw text in layout mode using a 14-point font, without any

continued

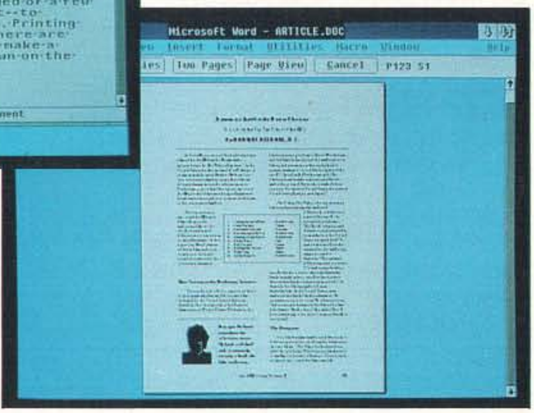
Photo 1: *Amí Professional lets you create styles for text through its dialog boxes.* ▼





◀ **Photo 2:** *Legend uses a special large font in draft mode that's easy on your eyes.*

▼ **Photo 3:** *In Word for Windows' print preview mode, you can move blocks of text, but the detail is lost.*



	Amı Professional 1.0	Legend 2.0	Word for Windows 1.0
Company	Samna Corp. 5600 Glenridge Dr. Atlanta, GA 30342 (404) 851-0007	NBI, Inc. 3450 Mitchell Lane Boulder, CO 80301 (303) 444-5710	Microsoft Corp. 16011 Northeast 36th Way P.O. Box 97017 Redmond, WA 98073 (206) 882-8080
Hardware Needed	IBM or compatible 286-based or higher system with a hard disk drive and Hercules, CGA, EGA, or VGA graphics	IBM or compatible 286- or 386-based system with 640K bytes of RAM, a hard disk drive, a mouse, and Hercules, EGA, or CGA graphics	IBM or compatible 286-based or higher system with 640K bytes of RAM, a hard disk drive, and any Windows-compatible graphics
Software Needed	MS-DOS 3.0 or higher	MS-DOS 3.0 or higher	MS-DOS 3.0 or higher
Price	$495	$495	$495
	Inquiry 881.	**Inquiry 882.**	**Inquiry 883.**

real formatting, and changed to another font just before the final printout.)

Then, there is the problem of positioning things on the page. Both Amí Pro and Legend use the "frame" approach, where you place frames (rectangles) that contain the graphics or text that you want in a certain spot on the page. You can only edit the text in a frame after you have selected that frame. You can move frames about on the page or from page to page as you would scraps of paper.

Word for Windows uses a text-based approach in which you "position" individual paragraphs, sections, or tables. You can position by hand to a certain extent, as with the frame approach, but you are expected to give the system a few rules and let it format the material by itself.

But all three packages stop short of giving you the kind of visual control that a true desktop publishing system like, say, Xerox's Ventura Publisher gives—where you define margins and line thicknesses to a thousandth of an inch. Instead, they give you a cookbook selection of line thicknesses and border patterns. This is probably just as well—most folks would rather produce documents, not experiment with typographic elements.

All three packages come with an optional single-application environment version of Windows, but if you run them under a full version of Windows, you can take advantage of the clipboard and import text or graphics from other applications. Thanks to Windows, you can also have those applications running in the background, flipping back and forth between them. (With Windows/386, you can even leave MS-DOS programs running in the background and grinding out data analyses or file conversions or whatever.) Also, an interesting Windows feature called Dynamic Data Exchange (DDE) lets you link data in one application to data in another, and as one changes, the other will also. (Both applications have to be loaded, of course.)

Keep in mind that Windows is responsible for the screen, printer, and mouse drivers, and third-party fonts are installed in Windows, not in any particular application. Having these details handled by the environment itself (i.e., Windows) has led to Windows' increasing popularity with software developers, who are spared the effort of handling such matters themselves.

Amí Professional

Of the three, Amí Pro has the most features. It has the basic word processing and desktop publishing features found in Amí "nonprofessional," which came out last year, but with numerous additions. It has a drawing facility for doing simple graphics, and a charting facility for making bar, line, or pie charts. In fact, Amí Pro comes with about a hundred examples of clip art in Amí Pro's own line-drawing format.

You can create and name styles (a combination of typeface and formatting features) through a series of dialog boxes that give you previews of what you have selected—on-screen representations of the font or format you've picked, before it's applied (see photo 1).

All three packages stop short of giving you true desktop publishing.

The program uses DDE, so, for example, you could link an entry in an Amí Pro document to a cell in a Windows Excel spreadsheet and change the entry as the cell changes. There are a sophisticated macro language, context-sensitive help screens, and a thesaurus as well as a spelling checker.

Amí Pro tries to embody the whole rationale behind Windows: integration, across or within applications. Thus, your computer becomes your personal assistant, capable of greatly magnifying and enhancing your efforts, rather than a balky tool that demands as much from you as you do from it.

However, Amí Pro has some problems. Loading the drawing or graphing modules can be so slow that you might as well exit and go to another system. Amí Pro would not import PCX (Publisher's Paintbrush) files, and other pictures that it did load were slightly distorted vertically, so that smiling people looked like vampires. I also kept getting meaningless "internal error" messages when performing search-and-replace procedures. And Amí Pro crashed a couple of times when I tried to move text through the Windows clipboard.

None of this, however, got in the way, since Amí Pro has something the other two lack—in fact, something rarely seen in full-featured word processors: It saves your text automatically at intervals in the background.

Legend

Legend might best be described as a simplified version of Amí Professional. It uses the same frame-based approach and includes a drawing function, but it lacks a graphing function, plus some "bells and whistles" such as formatting previews, document descriptions, and a word counter.

Its chief advantage is its draft mode, which does not use the (tiny) default Windows screen text that Amí and Windows Word use, but instead employs a larger, custom typeface (see photo 2). It saves your eyes from having to squint, and since it shows special tokens for carriage returns, it's easier to format E-mail and database downloads. But the use of the larger text also means that, under ordinary conditions, Legend's draft mode scrolls more slowly than its layout mode.

Legend also distinguishes itself by letting you define properties for frames. Therefore, instead of starting from scratch each time you create a frame, you can select from a list of frame types that you've already created.

Legend has no macro language, nor any use of DDE, a thesaurus, or context-sensitive help. While it still embodies more features than most users will probably ever want, it seems overpriced compared to Amí Pro.

Word for Windows

This program is really a superset of Microsoft Word, translated to Windows. Everything is text-oriented—graphics are embedded in the text, rather than placed in frames on the page. You can place text and graphics in "tables" and get some of the effect of frames, but the precision is not there—you can't, for example, wrap a poem around an irregular graphic. You can only move things around on the page while in print preview mode; you get a full page view, but the detail is lost (see photo 3). And there are no drawing or graphing functions.

But if all you need is to spice up a report with some proportional fonts, a logo, and maybe an occasional chart, Word for Windows is great. It offers that spice, plus a complete checklist of features typical of a high-end word processor—document version comparisons, an outliner, a thesaurus, variables you can embed in the text, and a document summary telling how many times the document was edited, for how many minutes, and by whom.

It even has a macro language that is actually a Microsoft QuickBASIC interpreter, allowing a word processing manager to not only customize, but actually change the appearance of Word for Windows. The program supports bidirectional DDE; for example, data that you type in through Word for Windows could affect a Windows Excel spreadsheet cell,

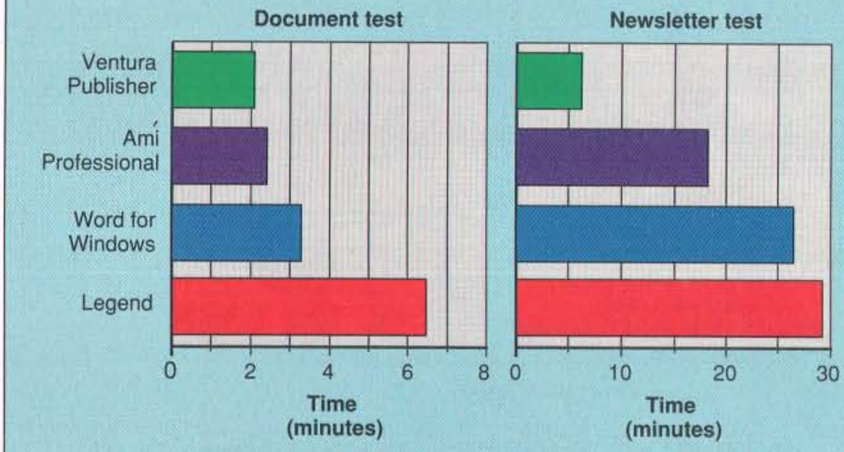
WORD PROCESSING TESTS

All three Windows word processors gave acceptable performance in most standard word processing operations. However, Amı Professional was notably faster at scrolling, and Legend took a relatively long time to load the test document. All times are in seconds.

	Search and replace	ASCII import	ASCII export	Reformat margins	Load	Save	Scroll
Amí Pro	5	5	4	2	4	4	10
Legend	14	9	4	3	23	5	36
Word for Windows	7	3	3	2	4	3	38

Note: Tests used a 4000-word document in 12-point Helvetica. The first test performs 400 search-and-replace operations. ASCII import and export tests time moving the document to or from ASCII format. The Scroll test moves from the top to the bottom of the document using the Windows scroll bar.

PRINT TESTS



Note: Printing times reflect how long it takes for the last page to appear. The document test is based on a 4000-word document printed in 12-point Helvetica with two columns but no graphics or other formatting. The newsletter test is based on a two-page newsletter with two graphics images (107K bytes and 46K bytes), seven type styles (five 12-point varieties, two 24-point varieties), and seven text blocks. All fonts had to be downloaded for both tests.

All three word processors proved to be much slower at printing than the page-layout program Ventura Publisher except for the simplest documents. Amí Professional was faster by far than either Word for Windows or Legend.

which in turn could change another cell and update another section of the original Word for Windows document.

Slow Performance

So much for the good news. The bad news is that while all three programs show passable performance while doing straightforward, one-column, text-based word processing tasks (see the table), further demands bring them to their knees rather quickly.

It can take a full minute to import a graphics file, and scrolling horizontally across a graphic can be torture as the picture is redrawn a section at a time. Especially with Legend (but the others are not far behind), you can get to the point where pushing one key will set off 30 seconds of hard disk activity before control returns. With the slow response and jangling hard disk, I felt I was operating a crane in a shipyard.

At first, Word for Windows seemed to be by far the fastest of the three. Invoking a screen menu does not trigger any disk activity, as it does with the other two programs. One might suspect that Microsoft, which surely knows all Windows' programming tricks, has used some of them. Alas, it hardly matters,

continued

because after you add some pictures and formatting to a page, Word for Windows becomes as slow as the others. Its layout mode can be glacial.

Meanwhile, printing speeds for all the packages were sometimes three to five times slower than those for Ventura Publisher (see the figure). Remember that all three packages did fine with straight word processing tasks—it's when you start making graphics-oriented demands that they wilt. But what's the point in going to the trouble of installing Windows and switching to a graphics-based word processor unless you can actually make use of the graphics? You might as well just stick to the old method of creating the text any way you want—any shareware word processor will do—and then importing the text into a desktop publishing package.

The culprit, of course, is Windows. While Windows gives each application automatic access to RAM above the PC's traditional 640K-byte barrier, that extra memory is really just disk emulation. What counts is the "conventional" memory below 640K bytes, where program modules are swapped in and out as they are needed. Basically, you have a large object (the code of these programs) being crammed into a small space (the RAM that Windows can allot to each is below 640K bytes). Of course, things aren't going to work as well as they might.

Amí Professional comes with unpublished Windows settings to change the way Windows allocates memory and thus, you hope, improve performance under certain circumstances. The other two vendors also have plenty of advice to offer. (Windows/286, for instance, may be faster than Windows/386, and it's best to use as much memory as you can for the disk buffer.) Using their suggestions did help somewhat.

But there's hope. Noises emanating from Microsoft indicate that Windows 3 is in the works and will make up for everything. It promises to do away with the 640K-byte barrier and give each application its own "virtual machine" with its own protected range of RAM. Everything will run faster because the applications won't be distracted by the constant need to juggle fragments of code in and out of slivers of RAM. Meanwhile, we remain stuck in the present, with three software packages offering much potential, shackled to the performance problems of the current versions of Windows.

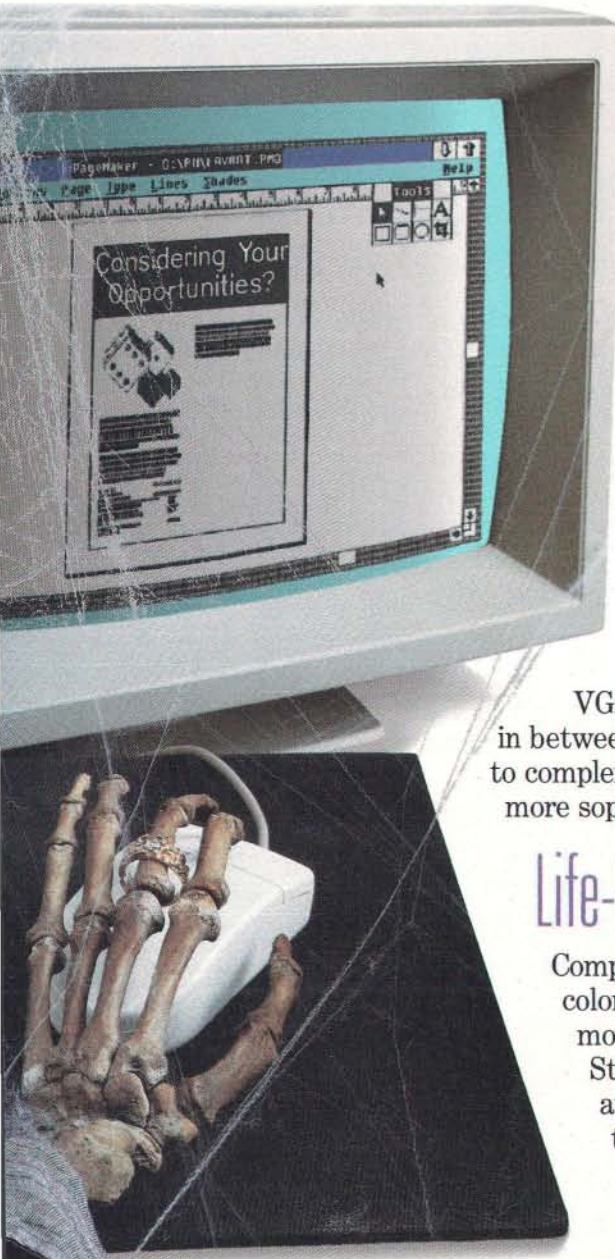
If you control the data processing in a large organization, then Word for Windows with its document production features and its macro language will appeal to you—assuming you're already using Windows. If you're a professional who's interested in coaxing the maximum use out of your personal computer, then Amí Professional will appeal to you. It offers a wealth of features, and the integration possible with Windows is just what a self-reliant professional needs.

If you want something simpler—if you just want correspondence with "high impact"—or if your glasses are getting too thick, you might consider Legend. It lacks DDE and a macro language, but if you're more interested in using your computer than configuring it, you may never notice. Either way, these three packages prove that PC word processing has an exciting future—as soon as it can escape from its past. ■

Lamont Wood is a computer journalist, desktop publisher, and data broker living in San Antonio, Texas. You can reach him on BIX as "lwood."

The New Hercules Graphics Station Card

Introducing the Hercules Graphics Station Card. With more features than any card in its class. And more power. The company that took the monotony out of monochrome now puts more zip into analog monitors.



Fast Graphics

In today's competitive business world, time is more precious then ever. But Windows applications like PageMaker, Excel, and Corel Draw can make you wait while they work. Not with the Hercules Graphics Station Card—it'll run Windows up to five times faster than a regular VGA card. At higher resolutions, too.

The secret is the on-board Texas Instruments 34010 graphics processor. It frees the CPU from the drudgery of graphics functions and screen memory control so you won't have to wait for your screen to catch up with you.

From VGA on UP

A whole megabyte of video memory lets the Hercules Graphics Station Card offer a full range of modes—from VGA up to 1024 x 768 resolution with 256 colors, and plenty in between. So it will run all your software—from general business to complex design programs. And as your software needs become even more sophisticated, you won't need to shop for a new video card.

Life-like Images

Computer images can look realistic when software can access more colors. The 16- and 24- bit color modes on the Hercules Graphics Station Card allow any standard analog monitor to display up to 16.7 million colors for high quality photo-realistic images.

And best of all, you can have all these features for less than you'd think. Call us at **800 532-0600, ext. 190** (U.S.) or **800 323-0601, ext. 191** (Canada) for the quickest way to your Hercules dealer.

Hercules

 Circle 133 on Reader Service Card

Takes the wait out of Windows!

The #1 Distributors In Europe & The Rim Now Sell The #1 Software Protection In The World.

Software developers creating the latest applications for IBM PC/XT/ATs or compatibles can now turn to local distributors for the *first-class* in *world-class* software protection.

Rainbow Technologies' Software Sentinel™ family of hardware keys is protecting over $1 *billion* in personal computer software. Right now. Worldwide. With virtually unbreakable security.

The hardware key concept is simple and effective. Developers incorporate unique codes in their software program which interact with the Sentinel key. The key is shipped with the program and must be connected to the PC in order for the software to run. It's that easy.

Choose Rainbow's SentinelPro™ for most applications or the Sentinel-C for custom configurations. Each model assures the developer that only *holders of the key* can run the software. Without adversely affecting the operation of protected or unprotected programs.

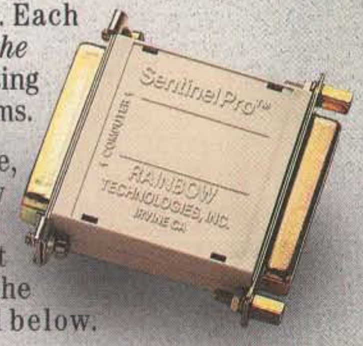
No matter where you sell your software worldwide, stay in control of your distribution and revenue by choosing the internationally accepted standard in protection. For additional information, contact Rainbow Technologies Ltd. in the U.K. or one of the European or Pacific Rim distributors listed below.

SentinelPro™

- Runs under DOS, OS/2 and Xenix, on IBM PC/XT, AT, PS/2 and compatibles, and Atari ST
- Algorithm technique (Never a fixed response)
- Parallel port version
- Minimal implementation effort
- Higher level language interfaces included
- 100 times faster than fixed-response devices (1 ms)
- ASIC design for reliability
- Evaluation kits are available

Sentinel-C

- Protects multiple packages with one device
- 126 bytes of non-volatile memory programmed before shipment of the software
- Rainbow supplies the developer a unique adapter for programming the unit
- Higher level language interfaces included
- Runs under DOS, OS/2 and Xenix, on IBM PC/XT/AT, PS/2 and compatibles
- Parallel port version
- Evaluation kits are available



EUROPE

- **FRANCE**
  Kontron Electronique
  Vélizy Villacoublay (Paris)
  tel: (33) 1 3946 9722
  fax: (33) 1 3946 0240
- **ITALY**
  BFI IBEXSA SPA
  Milan
  tel: (39) 2 331 00535
  fax: (39) 2 349 2344
- **BENELUX**
  IntroCom Electronica
  Hengelo, The Netherlands
  tel: (31) 74 430 105
  fax: (31) 74 429 895
- **SPAIN**
  MECCO
  Barcelona
  tel: (34) 3 422 7700
  fax: (34) 3 432 2847
- **WEST GERMANY**
  Kontron Datasystems GmbH
  Eching (Munich)
  tel: (49) 81 65 707-0
  fax: (49) 81 65 707 113
- **SWITZERLAND**
  IBV AG
  Birmensdorf (Zurich)
  tel: (41) 1 737 0176
  fax: (41) 1 737 1832
- **SCANDINAVIA**
  PERICO A/S
  Oslo, Norway
  tel: (47) 2 491500
  fax: (47) 2 397064

PACIFIC RIM

- **AUSTRALIA AND NEW ZEALAND**
  FMS Pty. Ltd.
  Melbourne
  tel: (61) 3 690 9899
  fax: (61) 3 699 7501
- **CHINA**
  Beta Trading
  Hong Kong
  tel: (85) 2 5 448963
  fax: (85) 2 5 459173
- **JAPAN**
  Giken Shoji Co., Ltd.
  Nagoya
  tel: (81) 52 251 4721
  fax: (81) 52 251 0229

Call Today For More Information.
DISTRIBUTOR INQUIRIES WELCOME.

Circle 245 on Reader Service Card (DEALERS: 246)

RAINBOW TECHNOLOGIES, LTD.

Shirley Lodge, 470 London Rd., Slough, Berkshire, SL3 8QY U.K. Tel: 0753-41512 Fax: 0753-43610
USA: Rainbow Technologies, Inc., 18011-A Mitchell South, Irvine, CA 92714 • (714) 261-0228 • TELEX: 386078 • FAX: (714) 261-0260

A Better dBASE

FoxPro pushed the dBASE language to its limits

Steven J. Vaughan-Nichols

For many years, despite determined competition, Ashton-Tate has been the dominant player in the dBASE game. Now, that could change. Fox Software's newest entry in the race is a clear winner over the other challengers.

FoxPro 1.00 is not just the latest bid to trump Ashton-Tate's troubled dBASE IV. Fox Software's $795 package has far more going for it than shaving a few milliseconds off indexing or adding a few dozen more procedures or commands, although it does do all that. Besides providing a high-performance superset of dBASE III Plus and IV commands, FoxPro brings a character-based windowing interface to the PC by way of the well-received FoxBASE+ Mac. As a result, dBASE programming will never be the same.

FoxPro also comes with a nonprocedural, object-oriented front end for its database manager. You can still use the keyboard with the new interface, but the program works best when you use a mouse. The FoxPro interface is about as far removed as you can get from the dot prompt and still be dBASE compatible.

The new interface isn't just for DOS-phobic users, though. Even the most dyed-in-the-wool command-line programmers will be impressed by FoxPro's ability to dynamically move, resize, and temporarily erase windows. It is possible to have an editing, a trace, a debugging, and an output window all either on-screen or a mouse-click away. Combine this with the ability to dynamically set breakpoints, a source code-level debugger, blazingly fast speed, and compatibility with both its own and Ashton-Tate's products, and you have a state-of-the-art dBASE development environment.

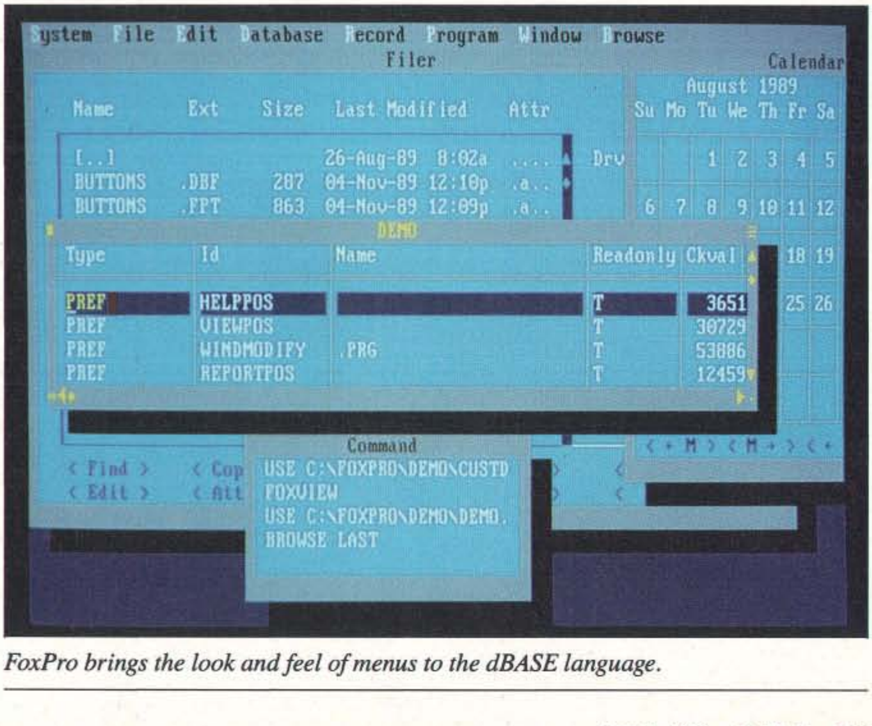
That is all very nice in theory, but dBASE IV 1.0 was also supposed to be the greatest thing since sliced bread until the bugs started popping up. To get my feet wet with FoxPro and to see how well it really worked, I performed a major overhaul on a 3000-line application that had started life in dBASE III Plus, and whose code had been expanded during a brief fling with Clipper.

Code Repair Made Easy

Installing FoxPro was a snap. The program, weighing in at more than 3 megabytes, comes in compressed form on merely five 360K-byte floppy disks. The installation program works automatically and, with a minimum of fuss and bother, transfers the program to your hard disk and then expands it without trying to rewrite your AUTOEXEC.BAT or CONFIG.SYS files. You probably will need to change your CONFIG.SYS file, though, because FoxPro needs every file handle it can get. The company recommends that your CONFIG.SYS be set to at least 40 files.

The documentation that comes with the program is well written. It's arranged in such a way that it's easy to use whether you're a novice learning the program or a grizzled dot-prompt veteran looking for examples of obscure command syntax. Unfortunately, the program it's written about isn't quite the same as the one you get. The release notes include no fewer than 47 pages of errata and additions to

continued



FoxPro brings the look and feel of menus to the dBASE language.

FoxPro 1.00

Company
Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162

Hardware Needed
IBM PC or compatible with 512K bytes of RAM, one floppy disk drive, and a hard disk drive with 3 megabytes of free disk space

Software Needed
DOS 2.1 or higher

Price
$795

Inquiry 886.

the main documentation. It's nice knowing the changes made, but I wish the company had integrated the information directly into the manuals, where it belongs, even if it meant delaying the program's release.

I had never seen my project's code before, so the first thing I did was sic FoxPro's integrated documenter, FoxDoc, on it to see what it could make of the hundred or so procedures and 50 programs. About 3 minutes later, I was looking at a system summary that included a complete tree structure, a variable cross-reference list, and summaries of indexes, formats, labels, procedures, and report files. FoxDoc prettied up the code and added comments that included file and procedure calls and listings of all called data and format files. This was a world of improvement over the documentation that came with my program—none. For this alone, I can highly recommend FoxPro to the legion of dBASE code repairers.

After going through the code, I then began tuning it up and adding the new programs required to expand the system's capacities. Again, FoxPro proved to be a godsend. It let me easily jump from watching the program's output to tracing the code and then to watching my debugging routines while dynamically setting variables and breakpoints.

Compared to previous FoxBASE releases, FoxPro has expanded support for user-defined functions. It's still not the equal of Clipper in this respect, though. You can't directly link C or assembly code for that extra performance edge. For this application, however, I could live without that ability.

FoxPro's internal editor is a good one, but I missed the WordStar-compatible commands of Ashton-Tate's editor. Still, it has one outstanding feature that I wish more true word processors had: It lets you retrieve any text deleted during an editing session. On the minus side of the balance, while the editor lets you move and copy text from window to window, it requires an extra step to do it. In theory, FoxPro allows you to call an outside editor in place of its internal editor. In practice, there wasn't enough memory left over for WordStar 5.5, my editor of choice.

Quick and Compatible

Despite its graphical user interface, FoxPro is impressively quick. A first look at FoxPro might make you think that it would be as slow as many Microsoft

continued

Windows-based programs. That's because its text-mode windows require only a fraction of the display memory that a true GUI requires. The end result is one of the smoothest and fastest windowing interfaces around.

The Browse command is also better than previous implementations. It now has two types of window formats. The first is the usual spreadsheet-like format, while the other corresponds to an Edit window. You can toggle between the two layouts at will. The real strength of the new-and-improved Browse is the ability to dynamically choose what fields or subsets of fields will be displayed, their size, and the order in which they will be displayed.

Despite some difficulties, mostly with Clipper commands that FoxPro doesn't support, I was able to finish the project in about half the time it would have normally taken me—and that includes learning time. There is one caveat to this. I was using a mouse. If I had relied on the keyboard alone to get my work done, it would have gone much more slowly. It's not that the program's key selections are poor, it's just that the program is at its best when mouse-driven.

FoxPro proved to be perfectly compatible with the dBASE III Plus dialect of dBASE. A series of tests on a number of dBASE IV programs that I had lying about revealed no problems with the newer language variant. Unlike its Ashton-Tate predecessor, FoxPro proved to be bug-free.

The program also has no trouble dealing with dBASE IV's database and index structures, with the exception of dBASE IV's master index format (.MDX). Make no mistake about it, though, FoxPro is a superset of dBASE. Its indexes and its memo formats are not backward compatible with Ashton-Tate's products.

In particular, FoxPro's new memo format is not like anything seen before in dBASE. New memo fields are unlimited in length. If you want to have a megabyte-size memo, you can. To make these monstrous memos more manageable, they can be searched and manipulated by several of the more important string functions, including the AT( ) and SUBSTR( ) subroutines. This goes a long way toward making memos more tractable for serious applications. FoxPro can also store binary data in string or memo fields. You can keep digitized images, sounds, and executable files all within the database. Putting binary data to use in the system isn't easy. For this release, the feature is more of a neat trick than a useful tool.

Pluses and Minuses

One thing you can always count on in any new dBASE program is that its makers will claim that their new index structure is smaller and faster than its forerunners. The makers of FoxPro are no exception. But while it may have the fastest indexing routines, they're not always the most efficient in terms of space. FoxPro indexed my files as much as 47 percent faster than dBASE IV with only a minimal amount of expanded memory (see table 1). However, file size was more of a toss-up. For simple index expressions, FoxPro made files an average of 10 percent smaller than dBASE IV's. When an index was based on a long, compound string key, dBASE IV was marginally more efficient.

I based my comparisons on eight indexes—six for a database with 837 records (Database 1) and two for a database

continued

INDEX PERFORMANCE: FOXPRO VS. DBASE IV

Table 1: FoxPro averaged about 30 percent faster than dBASE IV, but the efficiency (i.e., size) of the files created was more of a toss-up.

	Database 1 indexes						Database 2 indexes	
	1	2	3	4	5	6	1	2
Time to create (seconds)								
FoxPro	6.0	5.6	3.8	4.8	8.5	7.1	5.0	5.7
dBASE IV	11.3	7.0	6.8	5.6	10.4	8.8	8.7	9.1
Index file size (bytes)								
FoxPro	15,360	10,752	10,752	8192	72,192	72,192	43,520	20,480
dBASE IV	19,456	14,848	14,848	11,264	70,656	70,656	45,568	21,504

Note: Indexes were created based on the following expressions:

Database 1:
1. index on str(year(date),4)+str(month(date), 2)+str(day(date),2)+tape_no to date
2. index on trim(tape_no) to number
3. index on trim(format)+trim(tape_no) to format
4. index on trim(location)+trim(tape_no) to location
5. index on trim(subject)+(tape_no) to subject
6. index on trim(title)+trim(tape_no) to title

Database 2:
1. index on trim(key) to keys
2. set unique on
   index on trim(key) to uniq_key

BENCHMARK DATABASE MAKEUP

Table 2: Of the two databases used to compare FoxPro and dBASE IV, the first consisted of 837 records using several key fields, while the second contained 1470 records and only one key field.

Field name	Field type	Length
Database 1		
Date	Date	8
Format	Character	3
Location	Character	3
Subject	Character	60
Tape_No	Character	4
Title	Character	60
Database 2		
Key	Character	20

with 1470 records (Database 2). The names, types, and lengths of the fields used are shown in table 2.

I ran the tests on an Austin 286 AT compatible running at 12.5 MHz with 640K bytes of conventional memory and 384K bytes of expanded memory. The system also had an 80-MB Plus Development Hardcard II disk drive with a BIOS disk access speed of 28 milliseconds and a 128K-byte hardware disk cache.

There are two points where dBASE IV still has the edge. The first is automatic screen generation—Ashton-Tate's product is easier to handle. The second is the report generator: I rate FoxPro's as equal to dBASE's except for one significant shortcoming. The other dBASE variations let you directly edit a report's code; you can't do this with FoxPro.

The company claims that its report generator is so complete that you'll never need or want to meddle directly with the code. Wrong. Expert dBASE programmers will still want to get their hands dirty working directly with the report's format. Still, for the computerphobes in the office, the nonprocedural, object-/event-oriented front end of FoxPro's report generator is easier to approach than dBASE's.

One of the more remarkable things about FoxPro is that it manages to perform its tricks in as little as 512K bytes of RAM and on your typical 70-ms, slow-as-death, XT-class hard disk drive. It's not fun, mind you, and the program really slows down, but you can do it. FoxPro sings, however, when used with a fast chip and EMS 4.0 memory—the more of the latter, the better. FoxPro will also put any 80x87 math coprocessors in your PC to good use. One thing to be noted, though, is that FoxPro is very sensitive to its environment. Even a small reduction in RAM, either normal or expanded, can make a big difference in its performance.

Of course, FoxPro isn't perfect. The program claims to "compile" files, but it doesn't. FoxPro creates and runs object code faster than it runs source code. You can create true run-time programs only with the purchase of the not-yet-available FoxPro unlimited run-time package, which will set you back an additional $500. You can't simply buy a professional developer's package.

The current package isn't ideal for LAN use, either. However, Fox Software says that it is working with Novell to produce FoxPro/LAN for NetWare.

FoxPro is not a relational database manager and doesn't support Structured Query Language. This is a problem. The relational database model is the wave of the future. SQL, the language of the relational database management system, provides fundamentally stronger query and manipulation tools than dBASE, but good microcomputer SQL implementations are still hard to find. The company says that the next major release of FoxPro will include a SQL interface, but it will take more than that to make a DBMS relational. It is a step in the right direction, though, and I look forward to seeing the revision.

If you just want to get at your data quickly or whip up a simple report, you will be very happy with Fox Software's new product. FoxPro brings more than just a Mac look to the DOS environment. You can master the bread and butter of simple database design (i.e., data entry and report generation) quickly and easily in FoxPro. The program would make a fine choice for most offices.

FoxPro stretches the single-user, single-machine flat-file database model about as far as it can go. I wish it included SQL and improved LAN suitability, but despite these reservations, I plan to use FoxPro for most of my dBASE applications development. ■

Steven J. Vaughan-Nichols is a programmer/analyst for Bendix (Lanham, MD) whose work currently includes designing a database that takes data from a Goddard Space Flight Center telephone digital switch. You can contact him on BIX as "sjvn."

CHEETAH GOLD 425™

Cheetah Gold 425/D™

- INTEL 25MHZ i486 CPU/FPU
- FULL 16MB of 70NS System Memory
- Tower Case with 450/W Power Supply
- ESDI Caching Disk Controller with Dedicated Processor and 512K Memory
- Super Fast 383 MB ESDI Hard Drive
- 1024 x 768 Premium VGA Card
- 14" Premium VGA Color Monitor
- 1.2MB & 1.44Mb Floppy Drives
- 2 Serial & 2 Parallel Ports
- 101 Key Keyboard
- Cheetah Gold 425/D $9,995 !
  (Other models from $5,995)
  - Price subject to change
  - 20% Refundable deposit required
  - Subject to availability of INTEL 25MHZ 80486 chips. A surcharge may apply if Cheetah's cost of i486 chips exceeds $950 each.
  - VISA, MasterCArd and American Express add 4%
  - Delivery date subject to the availability of i486 chips.

AWESOME . . . PERIOD

1989 BYTE AWARD OF DISTINCTION

BENCHMARKS

LOW NUMBERS INDICATE SUPERIOR PERFORMANCE

Source: Personal Workstation Magazine - Great Performers section
Benchmark numbers are the average of: Software Development, Engineering/Scientific, Publishing and Financial from the AIM Benchmarks – UNIX Workstation section

Cheetah Gold 425™ with 8.0mb of memory and DPT caching disk controller

Cheetah International, Inc.
1003 West Cotton Street
Longview, TX 75604

1-800-CHEETAH
(1-800-243-3824)
1-214-757-3001
1-214-753-0589 FAX

ACMA offers "...performance, expansion possibilities, better-than-average warranty, and reasonable prices. This is an impressive machine." "...our favorite is the ACMA 386/25 Business System." *PC Magazine 11-28-89*

Urgent News: Acma Slashes Prices

45 Day "Risk Free" Money-Back Guarantee -- Two Year System Warranty* -- Unlimited Lifetime "Toll-Free" Technical Support -- Replacement Parts Shipped Air Express FREE! -- Fastest Delivery In The Industry -- Flexibility Makes Ownership Easy -- Hearing And Speech Impaired TDD Service -- Commercial Leasing -- On-Site Service Available!

Complete 286 Business Package
Now! $1,265

***FREE** Surge Protector and Printer Stand*

ACMA's 286/12 with Intel's 80286/12MHz CPU - New Enhanced AT CHIPSet - AMI BIOS - 0 wait state - page mode interleaving - 512K RAM expandable to 8MB - 80287 math coprocessor support - ROM based setup - shadow RAM - 1.2MB or 1.44MB floppy drive - 20MB hard drive - dual hard/floppy controller - parallel and serial ports - eight expansion slots - 200watt UL approved power supply - enhanced 101-key keyboard - monochrome monitor and video card - Panasonic 1180 printer (192/38 cps) ***PC Magazine Editor's Choice Nov. 14,1989*** - 6' parallel printer cable - ten diskettes - computer paper - User's Guide and "Easyview" stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

Complete 386SX Package
Now! $1,799

***FREE** Surge Protector and Printer Stand*

ACMA's 386SX with Intel's 80386SX-16MHz CPU- AMI BIOS - Intel ChipSet - 0 wait state - page mode interleaving - 1MB RAM - 80387SX math coprocessor support - eight expansion slots - 200watt UL approved power supply - 40MB/28ms hard drive - 1.2MB or 1.44MB floppy drive - parallel and serial ports - enhanced 101-key keyboard - monochrome monitor with tilt/swivel stand and monochrome video card - Panasonic 1191 printer (240/48 cps) - 6' parallel printer cable - ten diskettes - computer paper - User's Guide and "Easyview" stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

Complete 386/20 Power Package
Now! $2,650

***FREE** Surge Protector and Printer Stand*

ACMA's 386/20 with Intel's 80386/20MHz CPU - AMI BIOS - 0 wait state - page mode interleaving - 1MB RAM expandable to 16MB - 80387 math coprocessor socket - built-in ROM based setup - 1.2MB or 1.44MB floppy drive - 65MB (28ms) hard drive - 1:1 interleaved hard/floppy controller - parallel, serial and game ports - eight expansion slots -200 watt UL approved power supply - enhanced 101-key keyboard - 16 bit VGA card - Color VGA monitor - Panasonic 1124 printer, 24 pin Near Letter Quality (NLQ), ***PC Magazine Editor's Choice Nov. 14, 1989*** - 6' parallel printer cable - ten diskettes - computer paper - User's Guide and "Easyview" stand - Microsoft DOS & OS/2, Unix, Xenix and Novell compatible. Upgrade with video options, larger hard drives, tape backups and printers.

286/12
Now! $745

- 45 Day Money-Back Guarantee!
- Intel 80286-12 CPU running at 6/12MHz (keyboard switchable)
- Chips & Technologies ***"NEAT" CHIPSet,*** and AMI BIOS
- 512K RAM, expandable to 8MB on system board
- 0 wait state with page mode interleaved architecture
- 384K Shadow RAM w/1MB option
- Eight expansion slots
- 200W UL, CSA & TUV approved power supply (110/220V)
- Supports EMS/LIM 4.0
- Supports 80287 math coprocessor
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy disk controller
- Parallel, serial & game ports
- Clock calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible.
- Choice of Mini or Standard case (Vertical case $150)
- 2 year warranty

With Monitor & Video Board	Mono	EGA	VGA
40MB/28ms	$1,229	$1,529	$1,629
65MB/28ms	$1,369	$1,669	$1,769

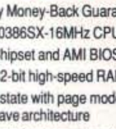
NEC 3D Monitor, & ATI Video Card With Mouse (PC Mag. Editors Choice 6/89) $890
Hyundai Color VGA Monitor & Acma VGA Video Card $458
Hyundai EGA Monitor & Acma EGA Video Card $419

386SX
Only! $995

- 45 Day Money-Back Guarantee!
- Intel 80386SX-16MHz CPU
- Intel Chipset and AMI BIOS
- 1MB 32-bit high-speed RAM
- 0 wait state with page mode interleave architecture
- Shadow RAM for system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80387SX math coprocessor
- Seven expansion slots
- 200W UL approved power supply
- ROM-based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock/calendar w/ battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible
- Choice of Mini or Standard case (Vertical case $150)
- 2 year warranty

Commercial leases start at $44/mth.*

With Monitor & Video Board	Mono	EGA	VGA
65MB/28ms	$1,695	$1,995	$2,095
120MB/28ms	$2,095	$2,395	$2,495



Only $95

Now, for a limited time, get PFS: First Choice for $95 when you purchase any Acma computer. You save almost 40% off the regular retail value of $149!

386/20
Now! $1,295

- 45 Day Money-Back Guarantee!
- Intel 80386-20 CPU running at 6/8/16/20MHz
- AMI BIOS
- 1MB 32-bit high-speed RAM, expandable to 16MB
- 0 wait state with page mode interleaved architecture
- Shadow RAM for lightning-fast system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80287, 80387 and Weitek math coprocessors
- Eight expansion slots offer tremendouse growth
- 200W UL, CSA & TUV approved power supply (110/220V)
- Built-in ROM based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2, Unix, Xenix and Novell compatible.
- Standard case (Vertical case $150)
- 2 year warranty

Commercial leases start at $57/mth.*

With Monitor & Video Board	Mono	EGA	VGA
65MB/28ms	$1,895	$2,195	$2,295
120MB/28ms	$2,295	$2,595	$2,695

386/25
Now! $1,495

- 45 Day Money-Back Guarantee!
- Intel 80386-25 CPU running at 6/8/16/25MHz
- AMI BIOS
- Cache Upgrades: 32K or 64K cache options available
- 1MB 32-bit high-speed RAM, expandable to 16MB
- 0 wait state with page mode interleaved architecture
- Shadow RAM for lightning-fast system & video BIOS relocation
- Supports EMS/LIM 4.0
- Supports 80287, 80387 and Weitek math coprocessors
- Eight expansion slots offer tremendous growth
- 200W UL, CSA & TUV approved power supply (110/220V)
- Built-in ROM based setup
- 1.2MB or 1.44MB floppy drive
- High performance 1:1 interleaved dual hard/floppy drive controller
- Parallel, serial & game ports
- Clock calendar w/battery back-up
- Enhanced 101-key keyboard
- User's Guide & "Easyview" stand
- MS-DOS & OS/2,Unix, Xenix and Novell compatible.
- Standard case (Vertical case $150)
- 2 year warranty

Commercial leases start at $66/mth.*

With Monitor & Video Board	Mono	EGA	VGA
65MB/28ms	$2,095	$2,395	$2,495
120MB/28ms	$2,495	$2,795	$2,895

Open 7 Days A Week!
800-456-1818

Hearing & Speech Impaired TDD 800-456-8898

Mon - Fri 7am to 6pm, Sat - Sun 9am to 3pm PST

VISA — Acma COMPUTERS, INC. — MasterCard

117 Fourier Ave., Fremont, CA 94539 (415) 623-1212 (415) 623-0818 Fax

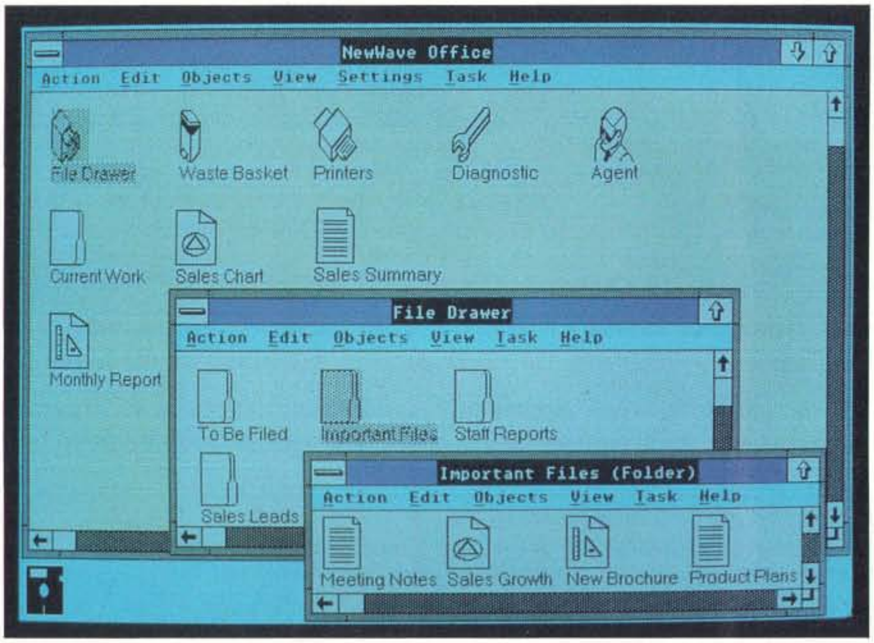
We accept Visa, Mastercard (no surcharge), American Express, C.O.D. via certified check, qualified P.O.'s, money orders, wire transfers, and personal checks (allow 7 days to clear). Cash, check or wire transfer prepayments get 1% discount. Add 3% for shipping and handling ($3 min.), or 4% for second day air on systems. In California add 7% sales tax. Call for shipping costs for Military addressed (APO/FPO), or if outside the continental United States. 45 day money back guarantee does not include monitors, accessories, return shipping and handling. Software, accessories, printers, monitors and shipping are not refundable. Replacement parts are cross-shipped via 2nd day air at Acma's expense with an approved RMA. Customers assume all responsibilities and costs for returning defective parts to Acma. We are not responsible for errors in typography or photography, and reserve the right to substitute equivalent, or better, parts. Prices and specifications are subject to change without notice, and all brand names are registered trademarks of their respective companies. *Two year system warranty –1st year parts and labor, 2nd year labor. Products not made by Acma are covered by the manufacturer's warranty. *Commercial leasing is for qualified businesses only, and the amount listed is based on a 36 month, zero down, 10% purchase option lease on basic configurations. ** Free shipping of Video Combos is by UPS ground , and covers the monitor and video card when purchased seperately from any other products.

Circle 11 on Reader Service Card

Windows Rides a New Wave

Hewlett-Packard's NewWave is nice, but is it too hard to use?

John Lussmyer



The top level of NewWave, the icon-based "office." Even minimal conversions of Windows applications to the NewWave office are not trivial.

When Microsoft Windows was first introduced, it started people thinking about the potential of a DOS-based graphical user interface. Still, even now, it seems that something is missing. While Windows provides a programming interface and a platform for graphics-based applications, it offers little in the way of amenities to users. Furthermore, while object-oriented paradigms apply well to GUIs, Windows' programming interface does not include many hooks that allow interface elements to be handled as objects.

NewWave, Hewlett-Packard's layered enhancement for Microsoft Windows, promises to change all that. Announced over two years ago, NewWave is supposed to bring a more robust feel to Windows. The goal was to make Windows easier to use and expand the range of functionality available to Windows applications. In this review, I'll examine NewWave, both the user interface and the programming tools, and weigh the benefits it brings against the hardships it creates.

NewWave is much more demanding than Windows. My system, an NEC PowerMate 386/20 with 4 megabytes of RAM and a 40-MB hard disk drive, just barely met the requirements of NewWave. On a 386 system, you need at least 4 MB of RAM and 8.5 MB of disk space. That's a tall order, but moving some files to the Novell network cleared up enough disk space.

The NewWave installation program decided that my system was not set up correctly, wrote out a lengthy error file, told me to read it, and quit. I would have preferred an explanation of the failure on the screen. The error file listed several problems with the way my system was set up. The error messages were fairly verbose and contained references to various application notes; I had a little trouble finding those notes. According to the error messages, my system didn't have any EMS bank pages above 640K bytes, it didn't have enough EMS RAM (installation had found only 80K bytes), it didn't have enough EMS RAM for banking (this time installation found 2528K bytes), the proper version of Windows was not installed, I did not specify a TEMP directory in my environment, and I did not have enough free disk space. If you didn't already know, NewWave is a very demanding, finicky environment.

I fixed the first problem by changing my 386Max installation. I never understood why NewWave saw only 80K bytes of EMS RAM, so I ignored the error. Decreasing the size of the disk cache gave me enough EMS RAM for banking. I had Windows 2.10 in my path; NewWave requires version 2.11, so I installed a newer copy. I then set up a TEMP directory. Finally, I made room on my hard disk drive, and NewWave was satisfied.

I had some questions about NewWave's use of EMS and called the HP NewWave support hotline. After a few levels of voice-mail recordings, I got another recording telling me that all the support people were busy and to please leave a message. I did, but no one returned my call.

continued

NewWave 1.0

Company
Hewlett-Packard Corp.
Santa Clara Information Systems Division
3410 Central Expy.
Santa Clara, CA 95051
(408) 749-9500

Hardware Needed
A 286 or 386 PC with 3 MB of expanded memory (EMS 4.0), a 20-MB hard disk drive, an EGA or VGA monitor, and a Hewlett-Packard or other Microsoft Windows-supported mouse

Software Needed
DOS 3.2 or 3.3; Microsoft Windows/286 version 2.11

Price
NewWave and support pack: $195
NewWave developer's kit: $895

Inquiry 887.

The Trouble with Windows

I had just finished installing Microsoft Windows 2.11 when I found the READ-ME file on the NewWave installation disk 1. Some of the instructions in this file tell you to replace certain files on the Windows installation disks with ones supplied by HP. So I made the changes and reinstalled Windows. If you ever have to reinstall Windows after you have installed NewWave, you must make some minor changes to the Windows installation.

This time when I ran the NewWave installation, everything seemed to run properly. A Windows/NewWave program performs a large part of the NewWave installation. This means that the installation runs slowly with long delays between disk swaps.

Problems began almost immediately after starting NewWave. Most of the Windows utility functions (e.g., Calc, Notepad, and HeapWalker) would not run. They aborted with a "not enough memory to run" message. One of the NewWave tools, Agent (an object that records and plays back user actions), just told me "Agent tool can't be opened in this release." Why was it installed? Every now and then, my NewWave session would inform me that it couldn't find one of its system files and to put it in drive A. Right. I didn't even know which distribution disk it was on. I *knew* that it was on the hard disk drive, but NewWave couldn't find it. I had to either put it on a disk in drive A or use the three-finger salute to reboot (losing any work in progress).

I called the NewWave technical-support line again, and this time I was quickly connected to a person. It turns out that the company has a new phone system and has had some problems with it, but the technical-support person was surprised to hear that no one had called me back. She was quite helpful and answered a few questions I had but couldn't figure out what was going on. The manuals had left me with the impression that NewWave worked only with EGA and VGA, which is wrong; it should work with any Windows-compatible video card, although NewWave has only been tested with EGA and VGA. She also verified that NewWave won't work with Windows/386. This was never explicitly stated in the manuals.

Within a couple of hours, the technical-support person called me again to get more information on my system. An hour or so later, she called and had another person there to help. We finally found that Windows 2.11 doesn't work with my Novell network. So I got on Microsoft's On Line support service and found that Microsoft had a fix for the problem, a new KERNEL.EXE (On Line knowledge base message Q44660). After downloading this and reinstalling Windows, everything started working fine.

Converting Applications for NewWave

A couple of days after getting NewWave running, I received the HP NewWave developer's pack. This is a set of disks with five binders' worth of manuals and another copy of the application notes.

The manuals are not especially helpful. HP really needs a book similar to Charles Petzold's *Programming Windows* (Microsoft Press, 1988) for NewWave. The most helpful manual is the HP NewWave Environment Programmers Guide. It describes how to convert an existing Windows application into a NewWave application, although it explains only a minimal conversion.

I did a minimal conversion of my Windows-based BIX conference viewer. My goal was to create a BixWin object that is a view of a specific portion of the message database. The changes required to even minimally convert an existing Windows application to work in the NewWave office are extensive. If your application makes use of the command line, you will have problems. NewWave has its own internal use for the command line, and, as far as I can tell, you cannot invoke an application from the DOS command line. It really wouldn't make sense in the NewWave object environment to do so. Any special command-line options you have will need to be implemented in some other fashion.

You must change two main functional groups of program code: those groups that use the Object Management Facility (OMF) and those that use the NewWave application programming interface (API). The NewWave OMF consists of a group of messages and functions that you must work with to handle NewWave objects. NewWave will invoke your application when the user (or another program) activates an object belonging to your application. This makes for some changes to the normal menu structure. The normal File menu is renamed Action, and some of the functions are changed. You will no longer have a `New` item; that function is handled by OMF. You can select `Objects` and then `Create a New` from the Office window. The function `Save As` will also create a new object.

Your application will also have more possible states of execution. A stock Windows application is either running or it isn't. Under NewWave, it can be inactive (not running at all), active, or open. When it's active, it creates its window but doesn't display it. A window is only displayed when the application is brought up to open status. This additional state requires changes to the application's initialization functions. You will always create the window, but you don't perform the `ShowWindow` or `UpdateWindow` function calls until NewWave sends you an OMF_OPEN message (which it may never do). To create a window, the `NW_CreateWindow` function is called, which replaces the existing `CreateWindow`. The initialization code also has to call the `OMF_Init` function to tell OMF what your window handle is. NewWave makes extensive use of property lists to maintain information about a window.

After you have called `OMF_Init`, you start getting OMF messages, and you must modify your main window procedure to properly handle them. The first thing your Window procedure must do with each message is call `NW_MessageFilter`. If this function returns `True`, you must immediately return to Windows with a value given to you by this function. You will also have to process some of the various WM_SYSCOMMAND messages. For SC_MAXIMIZE and SC_RESTORE, NewWave provides special functions that should be called. All other WM_SYSCOMMAND messages should be passed on to `DefWindowProc`.

continued

HOW TO COMBINE SPEED, POWER AND GRACE WITH BRUTE FORCE.

AUTOCAD® 386. Zoom faster. Pan faster. Draw faster. AutoCAD 386 combines world-standard CAD performance with full-force 32-bit workstation power—right on your 80386®-based PC.

AutoCAD 386 is built for speed. It loads, redraws, and saves drawings up to 62% faster than before. It accesses up to 16 megabytes of RAM and 4 gigabytes of virtual memory, making more room available for larger AutoLISP® and other applications programs, memory-resident drivers, network interfaces and other utilities—which translates directly into more speed.

Quick! Call Autodesk now to arrange a power-demo at the authorized Autodesk reseller nearest you. And upgrade your present version of AutoCAD for as little as $300.

AUTODESK

2320 Marinship Way, Sausalito, CA 94965
800-445-5415 Ext. 65

Circle 32 on Reader Service Card

In addition, you must set up a function to handle the OMF HAS_METHOD messages. This simply returns `True` or `False`, depending on whether your application supports that particular NewWave method. A method is just a name for a particular type of NewWave message. I do not understand why the company didn't provide a standard Window subclassing function to handle the `NW_MessageFilter`, WM_SYSCOMMAND, and HAS_METHOD handling. It looks like these handlers might be identical for all applications. The OMF already has all your HAS_METHOD information from your .IN$ file (a file similar to the Windows .DEF file).

I had a number of objects just disappear until I told NewWave to straighten up the screen and realign by rows.

HP has given quite a few style guidelines for NewWave developers to follow, one of which is that during activation, you get the title of the object being activated and display it in the title bar of the application. You also must obtain the filename and path from OMF and load the file. For BixWin, my objects are just a minimal specification of which conference, topic, and message are to be viewed. Since I wasn't doing this in the original Windows version, I had to add a menu item and code to read and write to the files. The menu that was most affected by this was the Conference View menu. I added Remember, which creates a NewWave object. When this object is activated, it starts a view of the message that was remembered. It is not an easy task to create a new object from within a program. You can only invoke the NewWave dialogue that the user normally uses. The user still has to fill in the blanks in the dialogue. There doesn't seem to be a way to simply create a new object of the same type that is executing.

In addition, do not use the undocumented Windows function `ExitWindows` from your application. NewWave will prompt with a message box that asks whether you really want to exit (which is probably what you were trying to avoid). It will also end up confused about the state of any objects on the screen. I had several objects just disappear until I told NewWave to straighten up the screen and realign by rows.

By the time you do a minimal conversion, your code will look considerably different. Your normal Windows initialization won't actually display the window. You will have added several new functions to process OMF messages, along with a bunch of calls to OMF function for initialization and termination.

HP recommends that you add the line EXETYPE WINDOWS to your .DEF file for proper operation. You also have to create an .IN$ file that gives NewWave some environment-specific information about your program. This includes a list of files that make up the executable file, whether default data files get copied when a new object is created, what methods are supported, and the name of your application.

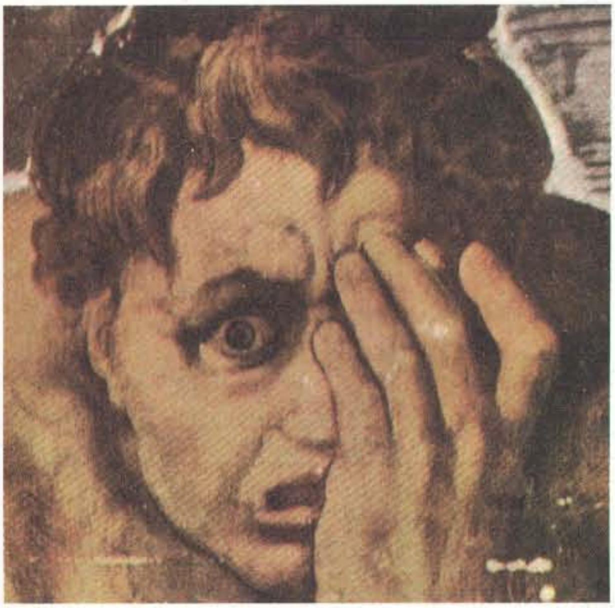
Going All the Way

At this point, your application will be more NewWave tolerant, but it won't yet fully exploit the new features. The second part of conversion will bring you up to a full NewWave application. This is the heart of the NewWave API: It supports the on-line help facility, Computer Based Training (CBT), and the Agent. I did not have time to perform a full conversion on my large BixWin application. I read the manuals and worked with the supplied sample programs. Each of the sections of the API requires extensive changes to the average application. HP tells you that setting up the Help facility requires no programming; then, a few pages later, there is a list of messages that you must process for Help to work. The Help facility looks nice when it is done. The major problem is writing Help text that makes sense.

Adding the last bit of NewWave functionality to an application renders it even more unrecognizable. You must add calls to quite a few API functions to determine if you are going to process the message, and if so, what to do with it. HP provides sample code sections that can be copied verbatim into your code. These are more correct, you hope, than the usual Windows sample code. Again, it looks like HP could have performed many of these functions by just subclassing the window when you create it. Most of these changes are to support a task language that should

continued

Death
Taxes
Software Piracy



We can save you from one of them.

Sorry. Death we can't do anything about. As for taxes, when you use our product you'll probably wind up paying more. But software piracy: there we offer some help. Our family of software protection devices (dongles) have improved unit sales for over 2,000 companies around the world. Our products can be used in the MS-DOS, OS/2 and Macintosh environments.

Build Your Own Custom Protection Environment

Use our patented "dual-locking" ASIC chip as the basic building platform. Next, add options like: on-the-fly read/write memory, write-once or multiple-write locking codes, and encryption shells. Then add your own programming creativity to build a protection environment best suited to your product.

Users attach the device to their parallel port, and programs won't run without it. Back-up copies, hard disk and LAN operation are not interfered with.

Your Intellectual Property Belongs To You

And if you don't protect it, who will? Our products offer the most equitable way to protect your interests without sacrificing the rights of your customers. Call us today for information and demonstration units.

Software Security

1011 High Ridge Road - Stamford, CT 06905
1-800-333-0407 ext. 101
203-329-8870 Fax 203-329-7428 BBS 203-329-7253
AppleLink™ D2379

Macintosh is a trade mark of Apple Computer Inc., Activator, Mactivator are trade marks of Software Security, Inc. illustration: detail from Michelangelo's Last Judgement

Circle 265 on Reader Service Card

be able to perform all the basic functions of your application. The Agent automates tasks by using this task language, even though much of the work is performed by the application.

Since most Windows programs were not written with a command language in mind, creating a complete one can be a difficult job in itself. HP suggests that you use its YACC (a spin-off from the Unix Yet Another Compiler Compiler, for which HP includes an advertising flyer) to generate the parser for the language. The manuals give examples of task languages and what to do with them, but using the examples causes some basic structural changes to your program. All commands can be processed by the same function. If you use dialog boxes—and who doesn't—you will have to make a number of changes. The dialog boxes should just return command codes for the main command processor to execute. You will not be perfoming much other than entry validation in the dialog box functions.

NewWave isn't easy to port to, but then, nothing worth doing should come easily.

The CBT support lets you write automated tutorials for your program. Again, it requires changes to your main window procedure so that it can monitor what the user is doing and supply actions when necessary. HP supplies a limited animation capability for CBT that helps make things a little more interesting. Creating the animation is a tedious job at best, though. I didn't have time to do more than look at the code changes necessary to support this, and they are considerable.

One of the more interesting features of NewWave is the data sharing, with which a view of your applications data can be pasted into another application. This view is wholly maintained by your application, but support is implemented by handling another set of messages that HP has defined. Again, the code to support this can be rather large. The examples given in the NewWave documentation were not very clear on what it takes to do this.

Another area in your application that will require modifications is the print support. NewWave objects print themselves using a different technique than is normally used by a Windows program. NewWave performs all printing by way of metafiles. The window procedure receives a message indicating that it should print a single page to the given metafile. After each page is done, the window procedure sends a message back to NewWave asking for the next page's metafile, and another message is sent when printing has completed. Since you are printing to metafiles, the normal Windows spooler isn't needed, and NewWave installation disables it by default. A side effect of this is that your normal Windows applications will print more slowly. If you are going to be doing much printing from a normal Windows application, you will probably want to reenable the spooler. Make sure you disable the spooler afterward; otherwise, the (effectively) doubled spooling will make the system seem slow.

Likable, but a Lot of Work

Overall, I liked using the NewWave interface. The icon-/object-oriented interface is easy to use and learn. When more applications are available, it should be a nice environment. I like the idea of sharing views of data between programs. This could make some of my normal bookkeeping a lot easier.

However, modifying an existing program to use is difficult at best. If you don't perform a complete conversion, there is no real advantage to the environment. If you do a complete conversion, you must rewrite major portions of your application. If you are planning to convert your application to the NewWave environment, you should sit down and figure out just what portions of it you need to or can support. The HP NewWave Environment Programmers Guide gives a good (although incomplete) description of how to convert an existing application.

The manuals need some help. If you run into a snag, the support line is good. In any case, expect to spend a lot of time reading the manuals and testing what you've written. NewWave isn't easy to port to, but then, nothing worth doing should come easily. ■

John Lussmyer is a software developer living in Troy, Michigan. He can be reached on BIX as "jlussmyer."

In the 1990s, code will be generated by the click of a mouse or a tap of a key. With Matrix Layout 2.0 you can do that now. And the results will surprise you.

Preview the 1990s with Layout

In Layout, you create programs by designing an object-oriented flowchart, with all the options of traditional programming. It's a technology we call desktop programming.

Once you're done, simply choose the language you want for the finished program. There's Microsoft C, Lattice C, and Turbo C, as well as Turbo Pascal and Microsoft QuickBasic. You can even create a .EXE file that's ready-to-run on any IBM PC or compatible.

1990s Power without 1980s Pain

Because Layout works with today's standards, you can painlessly take advantage of the power behind Layout – object oriented programming, CASE (Computer Aided Software Engineering) technology, hypertext databases, and graphical user interfaces. All without giving up your favorite computer language.

An Architecture for the 1990s

Layout comes with objects that produce real code for everything traditional computer languages can do – math, branching, variable management, complex data structures – and it extends each language to include powerful user interface and hypertext database capabilities. But best of all, you can extend Layout past the 1990s by building your own objects – BlackBoxes – that can do anything you imagine. Added together, Layout cuts your development time by up to 70%.

Welcome to the 1990s

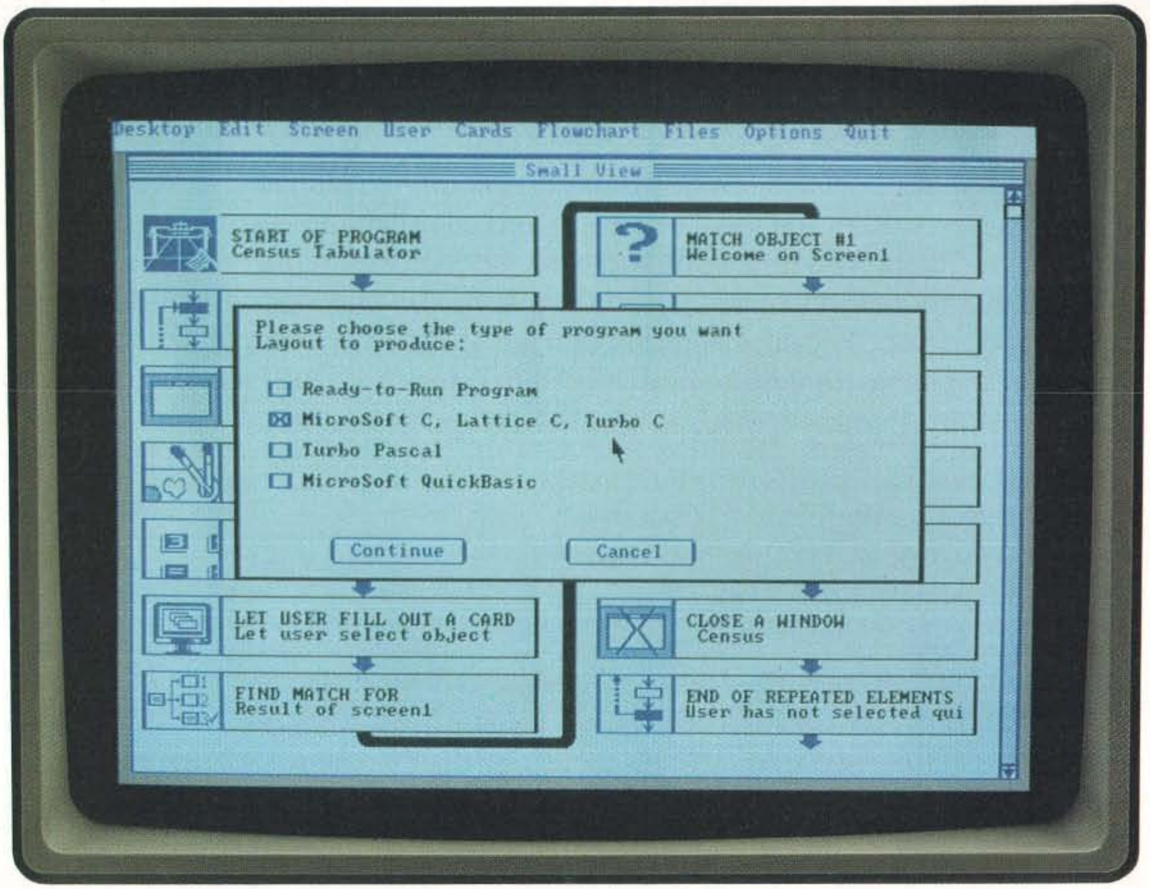
Ready to jump into the 90s? Get Layout today. It's available for just $199.95. Or for a glimpse of the 90s, see the Layout video tape for just $9.95. Give us a call at

1-800-533-5644

In Massachusetts call (617) 567-0037.

MATRIX
MATRIX SOFTWARE

In the 90s, this is how you'll write code.



Matrix Software Technology Corporation • One Massachusetts Technology Center • Harborside Drive • Boston, MA 02128
Matrix Software Technology Ltd. • Matrix House, Derriford Business Park • Derriford, Plymouth • Devon PL6 5QZ, England • 0752-796-363
Matrix Software Technology Europe N.V. • Geldenaaksebaan 476 • 3030 Leuven, Belgium • 016202064.
All trademarks and registered trademarks are of their respective companies.

Circle 178 on Reader Service Card (DEALERS: 179)

C Compilers Have Different Strengths

Two compilers bring object-oriented power to the Mac

Matt Mashyna

Apple has been dedicated to object-oriented programming—so dedicated that a substantial portion of System 7.0 is being developed in it. Object-oriented code is easier to control, from a software engineering point of view, and the Macintosh's interface suits it very well. Objects that respond to your actions with little dependency or knowledge of other objects free you from worrying about which window or area received a mouse-click or keystroke. The objects know what to do because the framework tells them when to handle an event and when to pass it on.

Apple started by adding object extensions to its Pascal compiler. Then Apple developed an application framework called MacApp. MacApp provided Pascal programmers with a fast development system that gave the programmer all the basic functions—text editing, scrolling lists, and views, to name a few—in self-contained objects. None of the objects required changes to be fully functional, and they were easily changed to meet new needs.

Now C objects are accessible to Mac programmers in two varieties: Symantec's Think C 4.0 and Apple's MPW C++ 3B1.1. Both compilers offer objects, but they are very different animals. Think C is a complete environment that meets the needs of the majority of programmers, while C++ is a more robust, powerhouse language for the MPW Shell.

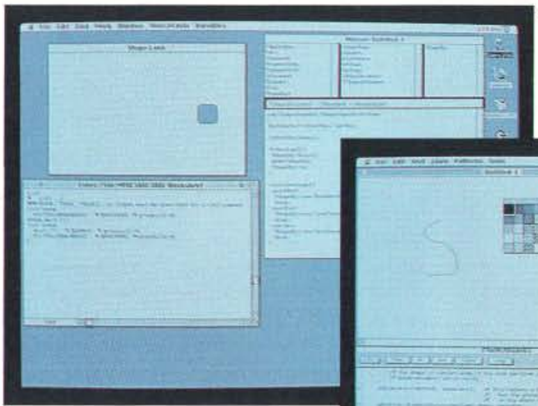


Photo 2: *Apple's Symbolic Application Debugging Environment debugger running with MPW C++.*

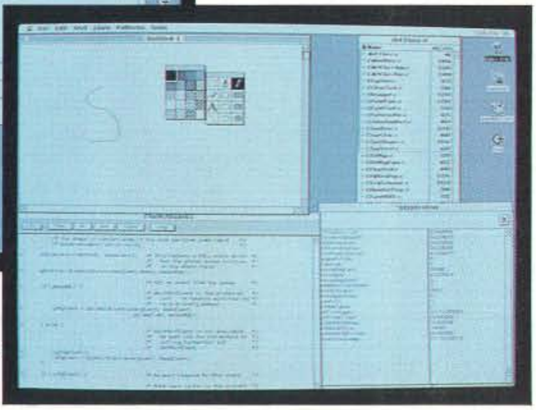


Photo 1: *Think C 4.0's integrated debugger.*

A Closer Look: Think C

The Think C environment is inviting, and it is streamlined for C development. The object extensions (make no mistake, Think C is not C++) provide you with tools to tame the Macintosh. The program offers a number of improved features, along with the object extensions, over version 3.0.

The new ANSI library supports all the ANSI standard functions. This is nice for portability. It replaces the Unix libraries from earlier versions. It also eliminates some old, peculiar functions in favor of more standard ones. Functions like `clalloc` and `mlalloc` and nonstandard string-to-number conversions are gone.

ANSI prototyping is now supported. This makes for better programs by forcing the compiler to check arguments in function calls and by forcing programmers to properly cast variables. In-line assembly is available, too, and it now accepts all MC68020 and MC68881 instructions and addressing.

A nice feature is the "Once only headers" that lets you define a preprocessor symbol at the top of your header files to prevent multiple inclusion. The rule is that if you define a symbol beginning with _H_ followed by the name of your include file, without the .h extension, it will not be processed a second time if it is included by other header files. For instance, the statement

```
#define _H_foo
```

within the file foo.h stops it from being included again, in case other header files also include foo.h.

Think C makes it easy to build multisegment code resources for desk accessories and device drivers and provides the ability to address globals using register A4 without affecting other applications' A5 addressing.

Another feature that I like is cdev debugging. Symantec has implemented a cdev object. The basic methods are already done, which means you only need to worry about the specifics of your cdev. An example with two projects is included. One project builds a real cdev, and the other builds an application with which you can use the debugger.

continued

MPW C++ 3B1

Company
Apple Computer
Programmers and Developers Assoc.
20525 Mariani Ave, Mail-Stop 33G
Cupertino CA, 95014
(800) 282-2732

Hardware Needed
Mac Plus, SE, SE/30, or II with 2 MB of memory and a hard disk drive

Software Needed
System 6.0.2 or higher; MPW Shell and C Compiler Bundle 3.0 ($400); MacApp 2B9 is optional ($100)

Price
$175

Inquiry 888.

Think C 4.0

Company
Symantec Corp.
10201 Torre Ave.
Cupertino, CA 95014
(408) 253-9600

Hardware Needed
Mac Plus, SE, SE/30, or II with 1 MB of RAM and a hard disk drive; debugger requires 2 MB of RAM

Software Needed
System 5.0 or higher; debugger requires MultiFinder

Price
$249

Inquiry 889.

Switching Channels: MPW C++

Apple calls MPW C++ "beta," but it is shipping the product unrestricted to end users, nonetheless. It consists of Apple's port of AT&T's Cfront preprocessor 2.0 (the latest) coupled with the standard MPW C compiler. As a bonus, the C++ package also includes version 3.1 of the C compiler, which has bug fixes over 3.0. This is a nice compiler with detailed warnings and error messages that tell you what went wrong and what it expected for arguments. Converting files from version 2.0 to 3.0 or 3.1 requires several changes, but Apple throws in a conversion tool that takes most of the pain out of converting.

A lot of the glue has been changed with respect to using call-by-reference versus call-by-value. You can count on making calls-by-reference, now, when *Inside Macintosh* says that the Pascal call uses a VAR. I also like the fact that it gives you many errors, depending on the severity, before it quits. I hate having to do fixes and then compiling the code over and over to catch each error.

To compare these products more evenly, I've combined C++ with MacApp. MacApp is Apple's object library. C++ does not come with a Mac-specific object library. MPW C++ is a complete C++ implementation, and it packs more punch than other object-oriented C compilers. Think C comes with its own Think Class Library. TCL is close to an older version of MacApp (1.1).

Both TCL and MacApp provide you with the basic objects that you'll need to get started, but MacApp is more refined. For example, setting up a scrolling region is effortless using MacApp, but using TCL, it can be a trying experience, at least the first time. MacApp has a Scroller object that takes care of scrolling any view that is embedded in it. TCL uses the older style of windows, scroll panes, and scroll bars that can be a hassle to coordinate. TCL also lacks some of the deluxe features that MacApp provides, like `TextListViews`, which displays scrolling lists of nearly any number of lines.

Stacking Them Up

These two products diverge after their object-orientedness. Think C has some features that I love. It's so easy to create INITs in C. It's also great to make inline assembly calls rather than link another assembled object module, because you can reference your C variables more easily in the assembly code. Another helpful item is Think C's console interface. It allows you to directly port Unix (and other) code that routes I/O calls through `stdin`, `stdout`, and `stderr`. MPW still doesn't do this outside of an MPW tool, and even then, it doesn't work well.

The Think C compiler is also very fast. The ability to include precompiled headers greatly reduces the time needed to read all the header files that are regularly included in your source files. I'm also a big fan of the symbolic debugger. You can't write debugging shell scripts, but it's nice to simply debug applications and cdevs. (It's a straightforward debugger with twin windows—one for source and another for data [see photo 1]. You can watch data and easily set breakpoints, with or without conditions. It reminds me of Microsoft's CodeView.) The Symbolic Application Debugging Environment (SADE) debugger has scripting and other powerful features, but its primitive interface is more difficult to master (see photo 2).

Besides the TCL shortcomings, Think C lacks the ability to create code segments over 32K bytes. It also pales in comparison to MPW's resource compiler. I also don't care for the giant project sizes that it creates. Since the compiler keeps all the object code handy in the project file, the compile/link time is fast, but I think I'd rather share object code between projects and keep them small. When you initially compile a project that uses the TCL, it takes a long time. After your project has been compiled once, though, the TCL doesn't need to be compiled again, and compile time dramatically decreases thereafter. The TCL can't be compiled into its own object-code library, because you would lose the ability to use the debugger on TCL classes.

The MPW editor has features that the Think C editor lacks (e.g., searching backward and marking text for quick reference). Most Unix C++ professionals will not like the fact that it is not C++. It is more akin to MPW's Pascal with object extensions.

As for MPW C++, its biggest feature is that it is *real* C++. You can take Unix C++ programs and expect them to compile. You gain C++ 2.0's multiple inheritance—the ability to combine components of different objects into one—the standard C++ I/O streams, and function and operator overloading (defining multiple functions with the same name). The features of C++ are many, and its power is great. I can't stress enough that these two products are not the same language.

A great virtue of MacApp is its debugging mode. MacApp creates executable files in two modes: debug and nondebug. In debug mode, you can examine your objects and browse through them via an Inspector window. This can be a big help when your object relationships are complex. The Think C debugger allows you to examine your objects, but it's not as handy. With just a few mouse-clicks and without cluttering the screen with data windows, the MacApp inspector gives you a lot of useful information based on the type of object that you're interested in.

When you get a lot of power in a product, you pay a price. The price for using C++ is time, space, and dollars. The compile time using MacApp can hurt. I

continued

The Pocket LAN Adapters for Token Ring, Ethernet and Arcnet.

Innovation comes in all shapes and sizes. At Xircom we believe it should fit in your pocket. Our Pocket LAN Adapters are revolutionary products developed for PC users who want the most convenient access to Token Ring, Ethernet or Arcnet networks.

What makes the Pocket LAN Adapters revolutionary? They require no internal slots, connecting through the parallel port of any IBM-compatible PC. All come supplied with certified drivers for a trouble-free solution that will have you connected in less time than it takes you to read this ad!

The Xircom approach has left the press full of praise: "The image of perfection–the way computers should be," wrote Steve Gibson in InfoWorld; "Incredibly easy to use...easy to install, easy to carry...a very clever device," according to Aaron Brenner at LAN Magazine.

You may think that all this "perfection" and convenience comes with a hefty price tag. It doesn't–in fact the Xircom family of LAN adapters costs about the same as the more traditional methods which it is quickly rendering obsolete.

It's living proof that with innovation on your side or in your parallel port, a little can take you a very long way.

Call Xircom today at (818)884-8755.

Xircom

LAN solutions for laptops.

22231 Mulholland Hwy., Suite 114
Woodland Hills, CA 91364
(818)884-8755 • FAX (818)884-1719

BEST of COMDEX BYTEWEEK Best Support Hardware Award FALL 1989

LAN PRODUCTS

1989 BYTE AWARD OF EXCELLENCE

count on an overhead of almost 2 minutes for each file that must include the MacApp headers. The folder that contains my MacApp files is around 7 MB in size. The price of C++ does not include the cost of the MPW Shell, MPW C, MacApp, or the SADE debugger. Perhaps by the time you read this, Apple will have a much faster version of MPW C++ that uses precompiled headers. That should diminish the compile time penalties for using MacApp.

If it sounds like I'm discouraging you from using C++, I'm not. Sure, it's expensive, but when you have all the required elements, the MPW shell with all its tools and flexibility is second to none. Those people who are used to working in a Unix environment will like it. The shell can be bent into the shape that suits you. You can even define shell scripts and variables. The Make facility is also much like Unix. Combining object code from different source languages is a snap. You can create your own tools to help you in your development. If you need a grep (pattern match) utility, just write your own and make it a part of the shell.

The MPW shell with all its tools and flexibility is second to none.

The Need for Speed

I don't think that speed is very important. It's more useful to know how the products compare as development tools. I took the basic, empty shells from Think C and MacApp and created an application with a scrolling, sizable, and zoomable window that did open, close, and save documents—all the basic things you'd want—and built an application with only these lines in the Draw methods:

```
MoveTo(10,10);
DrawString("\pHello, world");
```

The first time, Think C took 4 minutes, 50 seconds to compile on my Mac II. When I recompiled my application, document, view, and main files, the program took 29 seconds. Linking the project into an executable file took 12 seconds. The executable file size came out to be 57K bytes.

With MPW C++, the first compile, Rez, and Link took 2 minutes, 22 seconds. The next compile took 2 minutes, 7 seconds. The executable file size came out to be 92K bytes in nondebug mode and 254K bytes in debug mode. Note that the C++ source program was in a single file that was considerably smaller than the Think C source files, but the point of the comparison is to show the minimal source compile times using the basic frameworks of each class library. Because the integration of C++ and MacApp is not in its final state, Apple recommends that you include all source files in the main file so that, by including them only once rather than in many source compilations, you reduce the time to load the MacApp headers.

As for documentation, MPW C++ includes the standard AT&T C++ product manual, library manual, and selected

continued

BAYTECH MULTIPLEXER-CONTROLLERS

14 Years of Quality Multiplexing

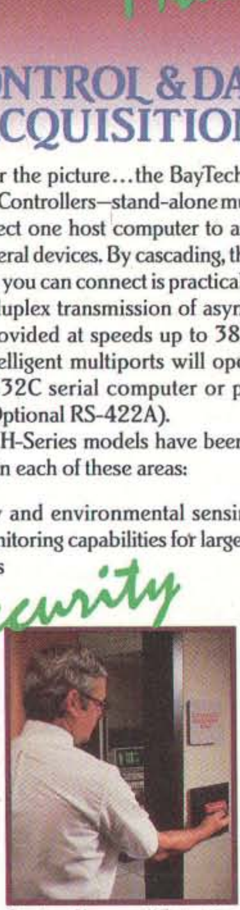
CONTROL & DATA ACQUISITION

Enter the picture…the BayTech H-Series Multiport Controllers—stand-alone multiplexers that connect one host computer to as many as 23 peripheral devices. By cascading, the number of devices you can connect is practically unlimited. Full duplex transmission of asynchronous data is provided at speeds up to 38,400 bps. These intelligent multiports will operate with any RS-232C serial computer or peripheral device. (Optional RS-422A).

The H-Series models have been used extensively in each of these areas:

- security and environmental sensing, to improve monitoring capabilities for large and small businesses

Security



Courtesy Honeywell Protection Services.

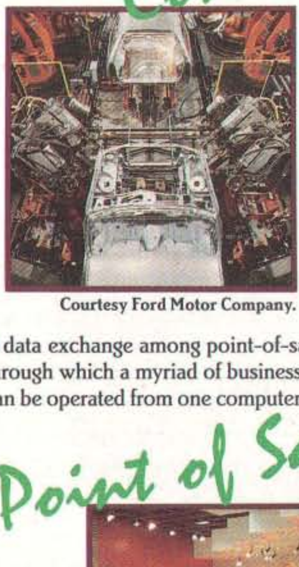
- medical data monitoring environments, where speedy responses are vital and critical information must reach the host computer immediately

Medical Data Systems

Courtesy Siemens Life Support Systems.

- industrial robotics-control environments, where multiple numerical or assembly-line machines can be centrally controlled

Process Control



Courtesy Ford Motor Company.

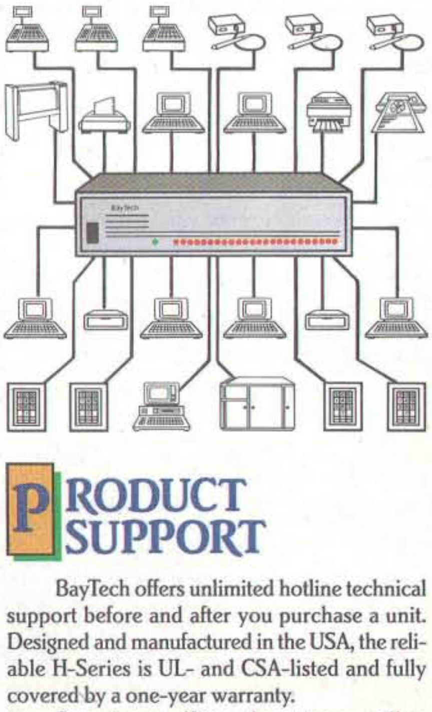
- data exchange among point-of-sale devices, through which a myriad of business equipment can be operated from one computer

Point of Sale

Courtesy Hugin Sweda.

SIX MODES OF MULTIPLEXING

To meet individual needs, these flexible, multifunctional devices are easily tailored by selecting one of six modes of multiplexing: time-division, port expansion/sharing, and four modes of buffered message multiplexing. In a typical application, the host port may be connected to a computer and the peripheral ports may be connected to such devices as: bar code readers, cash registers, fire alarms, numerical machines, modems, plotters, printers, security systems, and terminals (see illus.).



PRODUCT SUPPORT

BayTech offers unlimited hotline technical support before and after you purchase a unit. Designed and manufactured in the USA, the reliable H-Series is UL- and CSA-listed and fully covered by a one-year warranty.

So put yourself into the picture…call us today to learn about the many ways the H-Series Multiplexer-Controllers can benefit *your* business.

BayTech

Bay Technical Associates, Inc.
Data Communications Products Division
200 N. Second Street, P.O. Box 387
Bay St. Louis, MS 39520 USA
FAX: 601-467-4551
Phone: 601-467-8231 or toll-free

800-523-2702

Circle 43 on Reader Service Card (DEALERS: 44)

readings. It's a hefty package that tells you just about everything you'd want to know about C++. The examples are the usual simple text editor and drawing applications. The MacApp documentation is very complete.

I like the Think C manuals. They are very clean, and it's easy to find what you need. The Class documentation lists each TCL class with its ancestors and descendants. Each method is listed with its parameters. A complete manual of standard C library functions is also included.

What do you need to harness these tools? For Think C, you'll need 1 MB of memory (2 MB to use the symbolic debugger), 1.5 MB of hard disk storage or two 800K-byte floppy disks, and Finder 4.2/System 6.0 or higher.

MPW C++ requires the MPW Shell, MPW C 3.1, SADE for debugging, at least 2 MB of memory (realistically, you'll need 5 to 8 MB), an additional 2 MB of disk space over what the MPW Shell uses, and, again, Finder 4.2/System 6.0 or higher.

Objectively Speaking

As I've pointed out, these are two different languages. They can both function to merely compile C code, but that's not what should compel you to buy one over the other. I think of Think C as the Swiss Army knife of compilers. It does so many nice things. I can't imagine wanting to write an INIT in assembly language when I can use Think C. Think C makes building cdevs easy, too, and you can use the debugger on them. It's quick and simple for writing `printf`s to a window. For the price, you can't beat it. When I need to get something done in a hurry, I turn to Think C. In some cases, I use it to prototype methods of large C++ applications because of its sheer speed.

Why use C++ with MacApp? If you really want to exploit object-oriented programming, there's no substitute. MPW C++ is the real McCoy, and the MacApp library is very complete. They have been under development for over five years. They can save you from unexpected crashes and will manage memory segments. C++ comes with ViewEdit for creating everything from simple to extravagant and complex views.

I like both these products very much. If Think C had an improved class library, I'd be tempted to use it for everything, in spite of my dislike for its limited subset of C++, its editor, and its Rmaker resource compiler. I tend to use it more for its non-object-oriented features, but I do use the TCL for "light" applications. If you're on a budget, Think C is the way to go. You can get everything out of it that you would get from MacApp with a little more work.

For product development, I rely on MPW C++ and MacApp. In concert with their tools, I feel pampered. They are slower than Think C, but I don't run into problems building views because ViewEdit lets me create predictable results. For Macintosh interfaces, views are everything, and MacApp gives you much to work with. The MacApp library is very stable and has evolved past the TCL.

No matter which one you choose, I think you will be pleased. These are modern tools for modern times. This is your chance to get a jump on the next wave of programming trends. ■

Matt Mashyna is a software developer living in Pittsburgh, Pennsylvania. He can be reached on BIX c/o "editors."

Circle 215 on Reader Service Card

Find Out Why We're Rated No.1 for Service & Support.

"PC Brand is the LL Bean of personal computer mail order...
...PC Brand wants no unhappy customers,...it's service and support policies help to insure that."

-Personal Computing's 10 Best Mail Order Companies, Feb. 1989

286 SYSTEMS FROM $599

PCBRAND 286/12 ______ $599

12 MHz Clock, Zero Wait Operation, Norton SI 15.3 Landmark ™ Speed 15.1MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

PCBRAND 286/16 ______ $749

16 MHz Clock, Zero Wait Operation, Norton SI 19.0 Landmark ™Speed 20.6MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

PCBRAND 286/20 ______ $899

20 MHz Clock, Zero Wait Operation, Norton SI 23.0 Landmark™Speed 26.7MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

Standard System Features:

- 80286-12, 80286-16, 80286-20 operating at 12 MHz, 16MHz, or 20MH z w/Zero Wait
- 512K RAM expandable to 8MB on the System board using 256K or 1MB 100ns RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaved Hard/Floppy Drive Controller, 1Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports on std-configurations
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS w/full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0EMS hardware
- User configurable I/O timing permitting compatible operation w/older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/6 Disk Drive bays

Options:

- Low profile Slim Line Case w/3 Disk Bays available at no extra charge (pictured above)
- Mini Size desk top Tower ® Case w/4 bays
- LCD or Plasma Portable
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice

PC BRAND 286/12

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	$929	$1029	$1209	$1349
Mono	$1049	$1149	$1329	$1469
VGA-Mono	$1229	$1329	$1509	$1649
VGA-Color	$1459	$1559	$1739	$1879
SVGA/Color	$1569	$1669	$1849	$1989

PC BRAND 286/16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	$1079	$1179	$1359	$1499
Mono	$1199	$1299	$1479	$1619
VGA-Mono	$1379	$1479	$1659	$1799
VGA-Color	$1609	$1709	$1889	$2029
SVGA/Color	$1719	$1819	$1999	$2139

PC BRAND 286/20

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	$1229	$1329	$1509	$1649
Mono	$1349	$1449	$1629	$1769
VGA-Mono	$1529	$1629	$1809	$1949
VGA-Color	$1759	$1859	$2039	$2179
SVGA/Color	$1869	$1969	$2149	$2289

30 -DAY MONEY BACK GUARANTEE

FREE FREIGHT

TOLL-FREE SERVICE AND SUPPORT

ON-SITE SERVICE BY TRW*

24 or 36 MONTH LEASING

AND A 5-YEAR WARRANTY

Best "Executive Decision" System.

-Personal Computing, Best Bargain Systems, Dec, 1989

"The PC Brand 386/SX-16 performed at least as well as the far costlier Compaq... We simply began marveling at what is surely the biggest bargain in personal computing"

-Computer Buyer's Guide, Cover Story, Oct, 1989

Intel 386 Technology at 286 Prices the 386SX-16 Only $899

PC BRAND 386/SX-16____$899

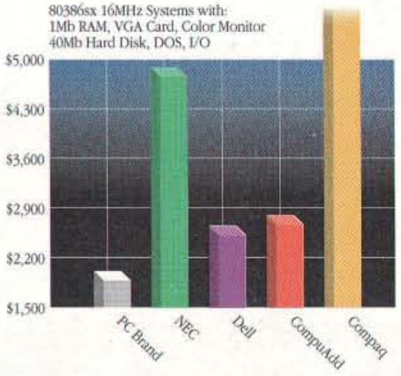
16 MHz Clock, Zero Wait Operation • Norton SI 18.7 Landmark™ 18.3MHz, 512K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

Standard System Features:

- 80386SX Processor Operating at 16MHz delivering 18MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1:1 Interleaved Hard/Floppy Drive controllers, 1 Mb/Second disk transfer rates on all 100 Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1Parallel ports on std-configurations
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case w/ 6 Disk Drive bays (Shown in optional Mini Size Tower ® Case)

Options:

- Low profile Slim Line Case w/3 Disk Drive bays at no extra charge
- Mini Size desk top Tower ® Case w/4 Disk Drive bays (as pictured above)
- LCD or Plasma Portable
- Factory Installed RAM Upgrades
- Custom configurations w/Name Brand peripherals of your choice



PC BRAND 386SX-16

w/512k, Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	20/40	40/25	66/25	100/25
No Video	$1229	$1329	$1509	$1649
Mono	$1349	$1449	$1629	$1769
VGA-Mono	$1529	$1629	$1809	$1949
VGA-Color	$1759	$1859	$2039	$2179
SVGA/Color	$1869	$1969	$2149	$2289

Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200. We are open Mon. thru Fri.: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**

*TRW-National Computer Maintenance Services

"PC BRAND 386/33 HAS FLAWLESS COMPATIBILITY, LOWEST PRICE"

InfoWorld, Product Review, January 8, 1990

FROM $2299

InfoWorld 386/33 Review Scores:

INFO WORLD EXCELLENT VALUE Jan. 8, 1990

PC Brand ____ 8.0
Compaq ______ 7.1
Gateway 2000 __ 7.1

386/33 CACHE ________ $2299

33 MHz Clock, Zero Wait Operation, Norton SI 45.9 • Landmark 58.7 MHz, 1024K RAM, 1.2MB or 1.44MB Drive, 101-Keyboard, 2 Serial and 1 Parallel Ports

"Here's a price $2799... [Now $2299] Must be stripped to nothing, Right? Wrong...You don't sacrifice quality for low price either. The PC Brand machines are an efficient combination of in-house engineering and top-notch off-the-shelf Parts."

-PC Magazine, 33MHz 386 PC's, October 31, 1989

"... great value. *Period*. ...excellent price performance ratio; high quality."

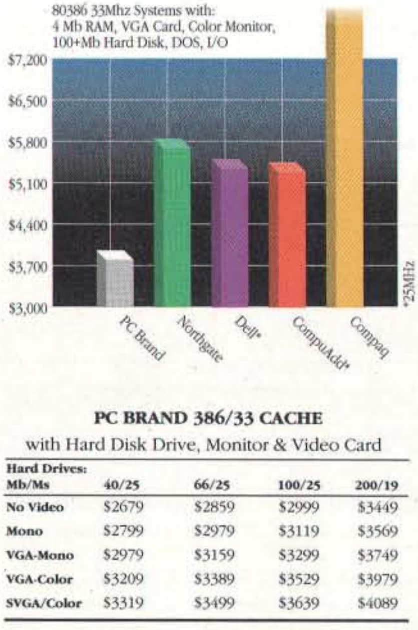
-Computer Buyers Guide, Product Review, February, 1990

Standard System Features:

- True 33 MHz INTEL 80386-33 CPU operating w/Zero Wait States Delivering up to 58.7 MHz Effective Throughput
- Intel 82385-33 Cache Processor with 32K 25NS Static RAM Standard
- 1024K RAM Standard Expandable to 16MB
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with 1024x768 capability on all VGA systems
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive/Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all 100Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial,1 parallel
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek Co-Processor support
- Phoenix BIOS with Full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- EMS and Disk Cache in ROM
- 8 Slot motherboard design
- Medium foot print case w/ 6 Disk Drive bays

Options:

- Full size Tower ® Case w/6 Disk Drive bays (as shown above)
- Custom configurations w/Name Brand peripherals of your choice
- Factory Ram Upgrades



PC BRAND 386/33 CACHE

with Hard Disk Drive, Monitor & Video Card

Hard Drives: Mb/Ms	40/25	66/25	100/25	200/19
No Video	$2679	$2859	$2999	$3449
Mono	$2799	$2979	$3119	$3569
VGA-Mono	$2979	$3159	$3299	$3749
VGA-Color	$3209	$3389	$3529	$3979
SVGA/Color	$3319	$3499	$3639	$4089

Turn the page for Portables & Peripherals

Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL. 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200. We are open Mon. thru Fri.: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**

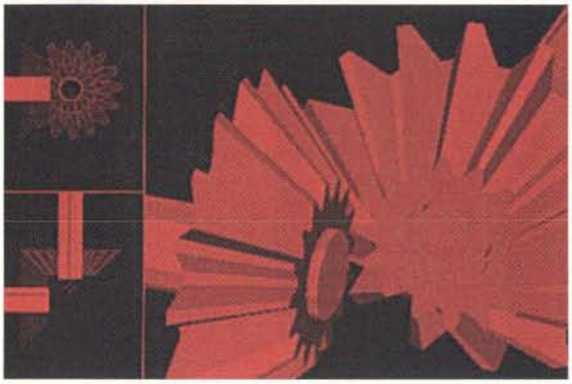
Portables With More Power than Desktops.

512K (286, 386/sx) or 1024K (386) RAM Serial and Parallel Ports, 1.2MB or 1.44MB Floppy, 86-key keyboard

The power, reliability and performance of our desktop system motherboards combine with our portable casing to make our system technically unique!

We support 3 built-in, externally accessible disk drives, enabling dual (3.5" and 5.25") floppys for *total* media compatibility. Including tape CD-ROM drives or other devices to deliver desktop functionality in a Portable Unit.

Simultaneous internal AND external monitor support, VGA functionality, 2 open card slots and our unique 3 drive support, permit this family to be used as a complete *"in the office system"* which you can pick up and take anywhere.



Actual VGA PLASMA Screen Image

Standard System Features:
- All performance and compatibility features as in desktops featured on previous pages
- 16 Grey Scale 640x480 VGA Plasma or 4 Grey Scale 640x400 CGA/Mono Graphics

Standard Features Continued:
- 3 Accessible Drive Bays for (2) 5.25" and (1) 3.5" Units
- 2 Available Peripheral Card Slots
- Simultaneous internal & external displays
- 200 Watt Auto Voltage Switching Power Supply

VVGA Gas Plasma Portables

Drives Mh/Ms	1 Floppy	40-25	100-25	200-19
286/12	$2595	$2995	$3395	$3960
286/20	$2795	$3195	$3595	$4160
386/SX-16	$2895	$3295	$3695	$4260
386/20	$3350	$3750	$4150	$4710
386/25	$3550	$3950	$4350	$4910
386C/25*	$4000	$4400	$4800	$5360
386C/33*	$4300	$4700	$5100	$5600

*32K Cached

LCD Backlit Portables

Drives Mh/Ms	1 Floppy	40-25	100-25	200-19
286/12	$1745	$2145	$2545	$3110
286/20	$1945	$2345	$2745	$3310
386/SX-16	$2045	$2445	$2845	$3410
386/20	$2495	$2895	$3295	$3855
386/25	$2695	$3095	$3495	$4055
386C/25*	$3145	$3545	$3945	$4505
386C/33*	$3445	$3845	$4245	$4805

*32K Cached

Monitors

NEC
GS-2A 14" MultiMono (to 800x600) $249
2A 14" SVGA (800x600) 479
3D 14" SVGA/EGA (1024x768i) 649
4D 16" SVGA/EGA (1024x768) 1150
5D 20" SVGA/EGA (1280x1024) 2350

Cornerstone Technology
19" Dualpage Display (1660x1280) $1950
19" Dualpage 16 level (1660x1280) 2795

Imtek/Samsung
14" VGA Color .31DP (640x480) $369
14" VGA Color .41DP (640x480) 299
14" SVGA Color (to 1028x768i) 419

Magnavox
Newest Models .... Call

Mitsubishi
1381 14" Diamond Scan (to 800x600) $499
HL6605 16" SVGA/EGA (to 1280x1024) 1195
HL6905 20" SVGA/EGA (to 1280x1024) 2095

Panasonic
C1391 PanaSync (to 800x600) $489
M1500 15" Mono DTP with adapter 1208
M1900 19" Mono DTP with adapter 1498

Princeton Graphics
Max15 14" Mono (to 1028x768i) $249
UltraSync 14" SVGA/EGA (800x600) 520
UltraSync 16" SVGA/EGA (1024x768i) 879

Princeton Publishing Labs
Multiview 15" Mono DTP with adapter $890

Relisys
9503 14" VGA Mono (640x480) $135
9513 14" VGA Color (640x480) 369
1520 15" SVGA (1024x768) 679

Seiko
1440 14" SVGA (1024x768i) $599
1450 14" SVGA (1024x768) 779

Sony
1304 14" SVGA (to 1024x768) $689
GDM-1606 16" CADD (1280x1024) .... Call
GDM-1953 19" CADD (1280x1024) .... Call

Zenith
ZCM1492 VGA Flatscreen (640x480) $619

RAM/I-O/Accelerator Boards

Intel
Aboveboard Plus 512K $419
Aboveboard Plus I/O 469
Inboard 386PC with 1M 595
Inboard 386 AT with 0K 859

PC Brand I/O Cards
AT 1P/2S/1G $49
XT 1P/1S/1G/Clock/Calendar 49

Video Cards

ATI
VGA Wonder 256K/512K $259/339
VGA Wonder V-RAM .... Call

NEC
Graphics Engine (1024x768i) 512k/1M ... $999/1349

Paradise
EGA Autoswitch 480 .... $139
VGA+ with 256K (8 bit) 219
VGA+ with 256K (16 bit) 249
VGA Professional 349
VGA 1024 with 512K 239
8514/A Plus .... 569 with VGA 649

PC BRAND VGA Cards

VGA 256K (8 bit) $99
VGA 256K (16 bit) 139
VGA 512K (16 bit) 189

"an outstanding device... compared with the 15 high performance VGA cards tested in PC Magazine's July 1989 issue."

PC Magazine, Product Review, Oct 31, 1989

Video Seven
1024i VGA with 256K $259
VRAM VGA with 512K 495

Fax Cards

Complete PC
4800/9600 .... $249/399
Complete Communicator 549

Intel
Connection Coprocessor $699

Quadram
4800/9600 .... $199/509

Modems

ATI
2400ETC Internal with MNP5 .... $165
2400ETC External with MNP5 205

Hayes
1200B Internal with Smartcom $189
2400B Internal with Smartcom 249
1200 External .... 256 2400 External 359

PC Brand ***(100% Hayes Compatible)***
1200 Internal with software $49
1200 External 70
2400 Internal with software 89
2400 External 129
2400 Internal with MNP5 129

US Robotics
Courier HST 14,400 External $599
Courier V.32 9600 External 889
Courier HST/V.32 External 995
Courier HST 9600 Internal 579

Tape Backups

Archive
ST600 60MB Internal with controller $590
FT60 60MB External with controller 590
FT150I 150MB Internal with controller 895
VP150I 150MB Internal Novell certified 925
VP150E 150MB External Novell certified 1175
VP402 Interface Board for VP Series .... Call
VP409 PS/2 Interface Board for VP Series .... Call

Colorado Memory Systems
DJ-10 Jumbo 40/80MB Internal $249
KE-10 External Chasis Kit with Interface 139

Maynard
Maynstream 60MB Portable $889
Maynstream 150MB Portable 1395
Maynstream 2200HS 2.2GB Portable 4350

Floppy Disk Drives

360K 5.25" Half Height Black $75
720K 3.5" Half Height Black 80
1.2M 5.25" Half Height Grey 85
1.44M 3.5" Half Height Grey 95
CMS 5.25" 360K PS-2 Internal 199

Sysgen
Bridge-File 5.25" 360K/1.2MB External $229
Bridge-File 3.5" 720K/1.44MB External 229
Bridge-File PC/AT Adapter 59

Hard Disk Drives

Compaq/Connor IDE Upgrades
40M 28ms $459
100M 25ms $679
200M 19ms 1249

Iomega
B1201 20M Internal $765
B1441 40M Internal 995
B244X Dual 5.25 44M External 1995
PC2/50 Nonbootable Card 230
PC2B/50 Bootable Card 230

Plus Hardcards
Hardcard 20 8 bit $539
Hardcard 40 8 bit 599
Hardcard 40 16 bit 599
Hardcard 80 16 bit 695

Seagate
20M 65ms ST225 Half Height $209
20M 35ms ST125 Half Height 245
30M 35ms ST138 Half Height 310
40M 28ms ST251-1 Half Height 349
40M 24ms ST151 Half Height 419
80M 28ms ST4096 MFM 590

Add $50 for XT Kit for ST1xx, ST2xx

Co-Processors

Intel

8087-1	$189	8087-2	$129
80287-10	229	80387-SX	309
80387-16	349	80387-20	399
80387-25	479	80387-33	639

NAME BRAND PERIPHERALS AND SOFTWARE AT THE LOWEST PRICES.

CD-ROM

Amdek
Laserdeck 2000 500MB External Kit $619
Microsoft
Bookshelf 1.0 ...... $195 Stat Pack $99
Programmer's Library 295
NEC
CDR77 External .. $555 CDR80 Internal $499
XT/AT Interface Kit 129
Clipart 3D .... 285 Image Folio 285
Sony
CDU510 Internal Kit $665
CDU1701 External Kit 779

Printers

(Numbers in Parentheses Indicate Draft/LQ CPS)

Brother
HL8e Laser .... $1875 HL8PS $3295
Canon
BJ130e 15" .... $769 LBP4 Laser $1025
LBP8-III Laser 8PPM 1725
Citizen
GSX 140 (192) .... $339 Color Kit $49
Epson
LX810 (180/30) .... $179 FX850 (330/88) $329
FX1050 (264/54) 439 LQ510 (180/60) 329
LQ850 (330/88) 495 LQ950 (264/88) 495
LQ1010 (150/50) 439 LQ1050 (330/88) 665
LQ2550 (400/108) ..... 899 EPL6000 6 PPM 939
Kodak Diconix
150Plus (150/50) .... $315 300WP (310/73) $439
Hewlett Packard
Deskjet Plus .... $710 LaserJet IIP $1025
Laserjet II .... 1720 Laserjet IID 2995
Laserjet III NEW! .... Call

Laser Jet Accessories

Pacific Data Products
Plotter in Cartridge $249
25 in 1 Cartridge 285
Postscript Cartridge 449
Turn your LaserJet into a Postscript Printer!
CPI
Superfont Cartridge $295
1M Memory Kit 269
2M Memory Kit 549
Princeton Publishing
PS-388 Postscript board $2250
Call about 400dpi Postscript Compatible Laser Printers

NEC
P220XE 192/54CPS $335
P9XL 400/190CPS 1030
LC890 8PPM Postscript 3190
LC890XL 8PPM 4MB 4495
SilentWriter II Printers .... Call
Okidata
ML320 (300/62) .... $345 ML321 (300/62) $479
ML380 (180/60) 359 ML390 (270/90) 475
ML391 (270/90) 655 ML393 (450/120) 995
Okidata OkiLaser 400 4PPM 1010
Panasonic
1180 (192/30) .... $189 1191 (240/48) $245
1124 (192/63) 299 1624 (192/63) 429
1695 330 Wide .... Call 4420 Laser .... Call
Logical Connection *Print Buffers*
256K .... $449 512K $529

**Oversized Monitors, Plotters, Laser Printers, and Portables excluded from Free Freight*

Networking Hardware

Gateway
G/Ethernet AT .... $435 for PS/2 435
G/Ethernet (8 bit) 265
Lantastic .... Call for Prices
Standard Micro
PS110 Board for PS/2 .... $439
PC500WS 16 Bit for WS 375
PC500FS 16 Bit for Server 449
PC550WS 16 Bit Twisted Pair for WS 395
PC550FS 16 Bit Twisted Pair for Server 495
PC270E Twisted Pair 139
PC130 Arcnet Board 135
ARCNET passive hubs / active hubs 72/359
ARCNET intelligent hub coax 495
ARCNET intelligent hub twisted pair 609
Synoptics
505UTP Transceiver $139
1000 Concentrator 2575
2500 Workgroup Concentrator 839
3Com .... Call for Latest Prices
Tiara
4 port hubs .... $49 8 port hubs $285
Lancard/A 8 bit ARCNET 89
Lancard/A 16 bit ARCNET Board 249
Lancard/E 8 bit Ethernet 199
Lancard/E 16 bit Ethernet Twisted Pair 339
Lancard/E 8 bit Twisted Pair 329
Tops
Repeater .... $125 Flashcard $155
Western Digital
Ethercard+ .... $219 A (PS/2) $320
Ethercard+ Twisted Pair 319
Xircom
Pocket ARCNET Adapter Coax $295
Pocket ARCNET Adapter Twisted Pair 295
Pocket Ethernet Adapter Twisted Pair 489

Plotters

CalComp
1023 .... $3450 1043DM $5700
Houston Instruments (Call for Prices)
DMP52 .... DMP52MP DMP61
DMP61DL .... DMP62 .... DMP62DL

Scanners/Digitizers

Complete PC *Scanners*
Full Page .... $499 Half Page $189
Hand Scanner 165
Kurta
IS/One 12X12 ..... $355 IS/One 12x17 ...... $509
Microtek
MSF 300G .... $1495 MSF 300Q $1275
MSF 400G .... 2750 MSF Edge Feed 1050
Summasketch *Digitizers*
12x12 .... $335 12x18 .... $599

Input Devices

CalComp WIZ .... Call
Logitech
Hi-Rez C9 Mouse .. $85 with Paint $99
Trackman 320DPI Serial/Bus 99/109
Microsoft Mice
Serial with Paintbrush $109
Serial with Windows 139
Bus mouse with Paintbrush 105

Novell Networking

4 User ELS Level I $429
8 User ELS Leve II 939
Advanced Netware 1850
SFT Netware 286 2850
Netware 386 4550

Network Utilities

CC: Mail
25 User .... $495 Expand $445
Cheyenne Software
Netback .... $189 Monitrox $505
Lan Systems
Lanspace .... $310 Lanspool $259
Norton-Lambert
Close-up Support/ACS $179
Close-up Customer/Terminal 135
Ontrack
Disk Manager -N ...... $99 Netutils .... Call
Tops
NetPrint 2.0 .... $115 Tops 2.1 .... $112
Traveling Software
Desklink 2.2 .... $95 Laplink III $92

Unix/Xenix Multiuser Products

Digiboard
Intelligent Serial Cards:
4/8/16 Port $645/795/1295
Wyse Terminals
WY60 .... $309 WY150 .... $305
WY370 14" Color .... Call
(Call on Keyboard options)
WY50 (with Keyboard) 389
WY86 (with Keyboard) 409

Santa Cruz Operations
Xenix 286 CompleteSys $995
Xenix 386 CompleteSys 1150
Xenix Software
Foxbase+ 386 .... $979
Microsoft Word 495
Open Desktop .... Call
VP/IX 1/3+ User 359/629
Xenix-Net 286/386 .... 439/479
Word Perfect 4.2 569

Supplies

Sony 5.25" 360K (box) $9
Sony 5.25" 1.2M (box) 14
Sony 3.5" 720K (box) 13
Sony 3.5" 1.44M (box) 25
5.25" Diskette Case 9
3.5" Diskette Case 11
Toner cartridge for HP DeskJet Plus, Laserjet II and IIp .... Call

Data Cartridges
DC2000 (each) $19
DC600 (each) 27
DC600XL (each) 29

**Free Freight in the Continental U.S.*

Power Protection Products

Tripplite
SK6 Spike Bar $29
IB4 4 Outlet Isobar 45
CCI+ Isobar 85
LC1200 Line Conditioner 159
BC325 Battery Back-up 279
BC450 Battery Back-up 349
OMNI450 or 450LAN Battery Back-up 419
BC750LAN Battery Back-up 459
OMNI1200 Battery Back-up 795

Software

Aldus Pagemaker $499
AMI for Windows 129
AMI Professional 319
Autosketch Animator 179
dBase IV 449
Borland Quattro ..... 95 Quattro Pro 279
Caere Omnipage 386 2.1 619
Corel Draw 329
Datastorm ProComm Plus 52
Delrina Perform 2.0 159
Delta Technology Direct Access 49
Deskview 386 115
Fifth Generation Fastback Plus 102
Foxbase + ... 189
Generic CADD Level 3 155
Harvard Graphics 329
IBM Displaywrite IV 249
Lotus Freelance Plus 329
Lotus 123 r. 2.2 ..... 339 123 r. 3.0 339
Microrim R:Base 489
Microsoft Excel 2.1 309
Microsoft Windows 386 125
Microsoft Word 5.0 205
Microsoft Word for Windows 325
Microsoft Works 99
Northedge Timeslips III 159
Norton Utilities Adv. 79
Paradox v. 3.0 .... Call
PC Tools 5.5 79
Peachtree Acctg III 149
Peachtree Complete III w/ Data Query 225
Professional Write 145
Quicken 39
Symatec Q&A 3.0 215
Timeline 3.0 379
Timeworks Publish It! 125
Word Perfect 5.1 249
Wordstar Pro 5.5 225
Ventura Publisher 2.0 499

Please Call For Other Business Software Titles

Free Freight*
30-Day Money-Back Guarantee
Toll-Free Service & Support
No Credit Card Surcharges

Call for Prices on Other Peripherals

Call 1-800-PC BRAND

(Call 1-800-722-7263) In All 50 States FAX# 1-800-722-7392

PC Brand, Inc. 954 W. Washington St., Chicago, IL 60607 Canadian Fax # 312-633-2888 Canadian Voice # 312-226-5200. We are open Mon. thru Fri.: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. **BYTE 15-4**

Even This Is More Confining Than Clipper.

Just as the vast expanse of the American West gave its settlers a new perspective on opportunity, Clipper's open architecture lends unprecedented freedom to application development.

Unlike fixed systems, Clipper never forces you to "make do". Its language is fully extensible with user-defined functions and new user-defined commands. You can extend the language with routines written in Clipper itself, or integrate code from other languages like C, Assembler, dBASE® and Pascal. Odds are, you already have knowledge you can use with Clipper!

But if a customizable language isn't enough, there's even more elbow room. Database and I/O drivers can be supplemented or replaced. Even Clipper's linker knocks down barriers by allowing you to develop applications larger than available memory, without defining overlays! And when you're done, Clipper's compiler generates stand-alone, executable files for cost-free, unrestricted distribution.

So, don't let the bounds of fixed systems fence you in. Unleash your imagination in the wide-open spaces of Clipper. To find out more, give us a call today.

Clipper® 5.0

The Application Development Standard

213/390-7923

nantucket®

Circle 200 on Reader Service Card

Reviewer's Notebook

Reviewer's Notebook is a compilation of brief reviews and updates to previously published evaluations. BYTE will publish Reviewer's Notebook each month as space permits.

Dot-Matrix Printers Rise Again

Dot-matrix printers may sound unexciting these days, especially with all those low-cost laser printers hitting the market. But Panasonic's new KX-P1624 24-pin entry is an intriguing, low-priced, full-featured workhorse that fills an important niche.

Panasonic designed the printer for offices that use dot-matrix printers day in and day out for such mundane (albeit necessary) tasks as printing reams of reports, multipart forms, or mailing labels—in short, for jobs where laser printers don't particularly shine.

The KX-P1624 takes forms up to 15 inches wide. It has five built-in letter-quality fonts: Courier, Prestige, Bold PS, Script, and Sans Serif. All are available in 10 different character sizes ranging from 5 to 20 characters per inch. There are also two draft-quality fonts.

Few dot-matrix printers match the KX-P1624's list of standard features. You can feed paper from four different directions (front, back, bottom, or top). A neat flat-belt tractor feed swivels to act as either a push or pull tractor. The push tractor (used with a built-in perforation-cut feature) is particularly handy for eliminating waste of continuous forms.

You will also find the usual paper-parking feature, which lets you print a single sheet without removing continuous forms. For those worried about software compatibility, the printer emulates the IBM Proprinter XL24E and the Epson LQ-2500. A 12K-byte buffer (expandable to 44K bytes) is standard.

At first glance, I found the printer's "EZ-Set" front panel difficult to understand. You work through several switches (there are no DIP switches) and a panel full of indicator lights to set up the KX-P1624. In the end, I figured out the switches in a short time, and the panel let me set up three macros for my most frequently used combinations.

With a print speed of 160 pica-size characters per second for draft and 53 cps for letter-quality text, the KX-P1624 isn't the fastest 24-pin printer available. But it's speedy enough for all but the most demanding environments. Panasonic could have made it faster, but that would have added to the bottom line, which may be the printer's most surprising feature: At $700, the KX-P1624 is hundreds of dollars less expensive than similar printers.

The KX-P1624's output doesn't match what you get from a laser printer, but I wouldn't be shy about sending out a manuscript, letter, or report printed on this printer to my most important readers. The printer does what it's designed to do and does it well. What's more, it's part of an encouraging trend toward feature-packed printers that won't clear out your wallet.—*Stan Miastkowski*

KX-P1624
Panasonic Communications
and Systems Co.
Office Automation Group
Two Panasonic Way
Secaucus, NJ 07094
(201) 348-7000
$699.95
Inquiry 853.

Superbase 4 Windows Outshines GEM Version

In the March 1989 BYTE, I reviewed Precision's Superbase 4, a full-featured database that ran on the GEM graphical user interface but could access only 640K bytes of memory. The program boasted the capability to incorporate graphics and text files as external database fields and had powerful relational capabilities. However, the 640K-byte memory limit and a number of bugs severely hampered the product. In addition, Superbase 4 suffered from inadequate documentation. I concluded that

continued

the program had great potential but needed additional memory, the elimination of several bugs, and improved documentation.

Precision seems to have addressed all my complaints in its recently introduced Superbase 4 for Microsoft Windows. Superbase 4 Windows supports both extended and expanded memory, allowing the display of bit-mapped graphics as database fields.

In addition, Superbase 4 Windows includes an external data type that can point to either a bit-mapped graphics file or a text file that can be searched for and queried. The product also includes a comprehensive programming language, a built-in text editor, a telecommunications facility for transferring files, and a powerful Structured Query Language query facility, as well as full-featured forms and report writers.

I checked the program for the bugs that I had found in the earlier GEM version, and all of them had been eliminated. In addition, the documentation has been upgraded and is easier to follow. The communications facility has been

greatly improved, and the VCR-like control panel, which controls the database, works much better than the one in the GEM version. The text-field search feature now works as advertised, and I found it much easier to manage multiple open database files than in the GEM product.

In spite of all these improvements, Superbase 4 Windows is not a product for the casual database user or for the faint of heart. The product has powerful capabilities for database application developers, but you can expect to encounter a steep learning curve before understanding how to really take advantage of those capabilities.

For example, the forms designer presents the user with two rows of more than 30 icons, the functions of which are by no means intuitive and which require a certain amount of effort to learn. The query and file-linking facilities are also complex, and they, too, take some diligence to understand.

Nevertheless, serious database developers for Microsoft Windows should find Precision's Superbase 4 Windows to be an excellent candidate for their development work.—*Nick Baran*

Superbase 4 Windows
Precision, Inc.
8404 Sterling St., Suite A
Irving, TX 75063
(800) 562-9909
(214) 929-4888
$695 with run-time version of Microsoft Windows
$995 for five-user LAN extension (total of six users)
Inquiry 856.

Making Smalltalk with OS/2

Digitalk has taken a large stride with Smalltalk/V PM, a version of its Smalltalk/V environment for OS/2's Presentation Manager. This new release holds great promise for those looking to step up to OS/2 from Digitalk's 286 version, as well as for developers seeking an easier method for developing PM applications.

Smalltalk/V PM makes it easy for OS/2 developers to build, in hours or days, complete applications that are indistinguishable from those built the hard way—with compilers, linkers, and so forth. Smalltalk/V PM hides the complexity of dealing with windows, input events, and the like until you're ready for them. I produced several applications with Smalltalk/V PM before I knew anything at all about PM. The result was that I could focus on the development problem at hand rather than on the user interface.

Although Smalltalk can be a self-contained, self-sustaining environment, Smalltalk/V PM produces *real* PM programs, with access to all of OS/2's advanced features, including Dynamic Link Libraries and Dynamic Data Exchange. Since any resource available under OS/2 and PM is available to Smalltalk/V PM, integrating V PM programs with those produced in conventional languages is simple.

For those who are already familiar with Smalltalk, Smalltalk/V PM offers some surprises. A new, simpler application model consists only of Models and Windows. A cleaner approach to graphics makes using custom graphics in an application much easier than before.

The changes from previous releases of Smalltalk are significant enough that porting to Smalltalk/V PM could be time-consuming, particularly if your application is graphics-intensive. If the application is loaded with homegrown Panes and Dispatchers that are not simple subclasses of the standard set, you may find it necessary to rebuild large portions of the program.

However, even with all the changes, the environment is still recognizable to users of Smalltalk/V 286 and Smalltalk/V Mac (the 286 and Macintosh versions). All the familiar user interface components remain available, and a few more have been added. Users of other Digitalk products will also feel right at home with the programming tools that come with Smalltalk/V PM. The browsers, debugger, and inspector work much as they did before.

Another key change that Smalltalk/V PM brings to the Smalltalk world is compilation. Instead of keeping track of the classes you define and objects you create in a set of data files, Smalltalk/V PM incrementally produces an .EXE file. This file, together with a single Dynamic Link Library, is all that's needed to run the application on any PM system. The resulting executable file is quite large, but Digitalk plans a Developer's Kit to address the problem.

On the whole, Smalltalk/V PM represents a significant new direction in Smalltalk environments. Its close integration with the host system, together with its much-improved application and graphics models, makes this environment far better than what has gone before. The power that it provides to OS/2 developers is valuable. Even if Smalltalk/V PM is used only for rapid prototyping, no OS/2 development team should be without it.—*Eric Smith* ■

Smalltalk/V PM
Digitalk, Inc.
9841 Airport Blvd.
Los Angeles, CA 90045
(213) 645-1082
$499.95
Inquiry 855.

Securing your data is as fast as one, two!

When you use DPT's SmartCache™ the caching controller with disk-mirroring.

Speed and security in one package.

SmartCache with disk-mirroring ensures uninterrupted operation in the event of disk failure by simultaneously writing data to your PC's primary drive and a secondary, "mirror" drive. SmartCache increases system speed and eliminates down time and data loss due to drive failure, thus providing true disk fault tolerance for all PCs.

When we say *fast*...

Unlike software disk-mirroring that actually slows your PC down, SmartCache dramatically boosts system speed, thanks to its state-of-the-art disk-caching technology. The on-board processor and expandable cache RAM allow the controller to simultaneously manage the primary drive and the mirror drive and still process data at 0.5ms for unprecedented speed and security.

Picture-perfect compatibility.

SmartCache needs no special ROM BIOS or software drivers and is fully compatible with *all* 286/386 PCs and *all* operating systems. Because SmartCache looks exactly like a standard disk controller to your computer, installation is quick and easy.

So smart, it can repair itself.

SmartCache actually repairs all disk errors *automatically*. Even catastrophic drive failures will not cause the system to crash.

Backed by the best: DPT.

Distributed Processing Technology was the first to develop caching disk controllers for microcomputers and is the recognized leader in the industry. Our products have been at work for over a decade, speeding up minis and mainframes. We offer a 1-year warranty, clear documentation, and outstanding technical support.

Look into SmartCache!

You'll like what you see. Call today and find out how you can add speed and security to your PC system—with SmartCache, from DPT.

132 Candace Drive • Maitland, FL 32751 • (407) 830-5522

DPT Distributed Processing Technology

Circle 96 on Reader Service Card (DEALERS: 97)

Applications Architectures

Editor's note: *You may notice something different about this section—the name has been changed from In Depth to State of the Art. This new name conveys more precisely the type of information this section contains and highlights the balance between this section of BYTE and the extensive "state of the market" product coverage elsewhere in each issue. While we'll still present information in the usual in-depth manner, it's now clearer than ever that this section is where we discuss the leading-edge technologies that herald the products, tools, and techniques you'll be using in the months and years to come.*

When you plan to construct a house, one of the first things you need is a set of blueprints. Until you have those, you don't know where to begin, how big a hole to dig, or what materials to buy.

In the past, writing applications software has been more like making bricks than building something with them. The developers each made their own bricks, some red, some brown, and some blond, some rectangular, some square, and some hexagonal. The end result has been lots of piles of bricks that don't always fit together the way you'd like them to.

The time has come to step back, make a blueprint of what you want to create, trying to incorporate as many of the pieces you already have as possible, and start construction. One name for this blueprint might be applications architecture, a framework for creating order out of the chaos of applications today.

This first State of the Art section begins with "Transparent and Portable" by Mark L. Van Name and Bill Catchings. In it, they describe the types of applications architectures available that provide a consistent framework across different machines. Currently, the Macintosh is the leader in this area in the personal computer field, but over the next few years, you can expect others to appear. Portable, transparent applications make life easier for all of us who use desktop computers.

Then, in "From TTY to VUI," Frank Hayes discusses user interfaces, their pluses and minuses, and how they compare. Many people today prefer a graphical user interface to the command-line interface, but how do the available GUIs compare with each other? Is it really safe to say "when you've seen one, you've seen them all"?

When you go behind the user interface, you come to the application programming interface. In "Behind the Scenes," Howard Eglowstein explores the next level of detail to consider when you choose a user interface: the capabilities behind it as reflected in the API.

Next, in "Bridging Troubled Waters," Jon Udell describes several cross-platform tools that let you use the same software on different machines. This concept and the products that use it solve the problem of which machine and which operating system to support. An application can be written once and then simply ported to a variety of machines.

In "Blueprints for the 1990s," Sheila Osmundsen provides a comparison of the two major applications architectures available today: IBM's Systems Application Architecture and Digital Equipment's Network Applications Support. More and more companies are exploring the advantages of these consistent frameworks: interoperability and greater portability across dissimilar platforms. New players are entering the field at a growing rate. The text box "An Open Approach" looks at Data General's recent entry, Distributed Applications Architecture.

As these architectures proliferate, will Big Brother be watching? Will you lose your independence? I don't think so. Rather, you will gain the freedom to move from one machine to another and from one operating system to another, without retraining. Knowing an applications architecture will broaden your usefulness and your sales appeal. Individually, you can still march to the beat of a different drummer, but, together, you can harmonize.

—Jane Morrill Tazelaar
Senior Technical Editor
State of the Art

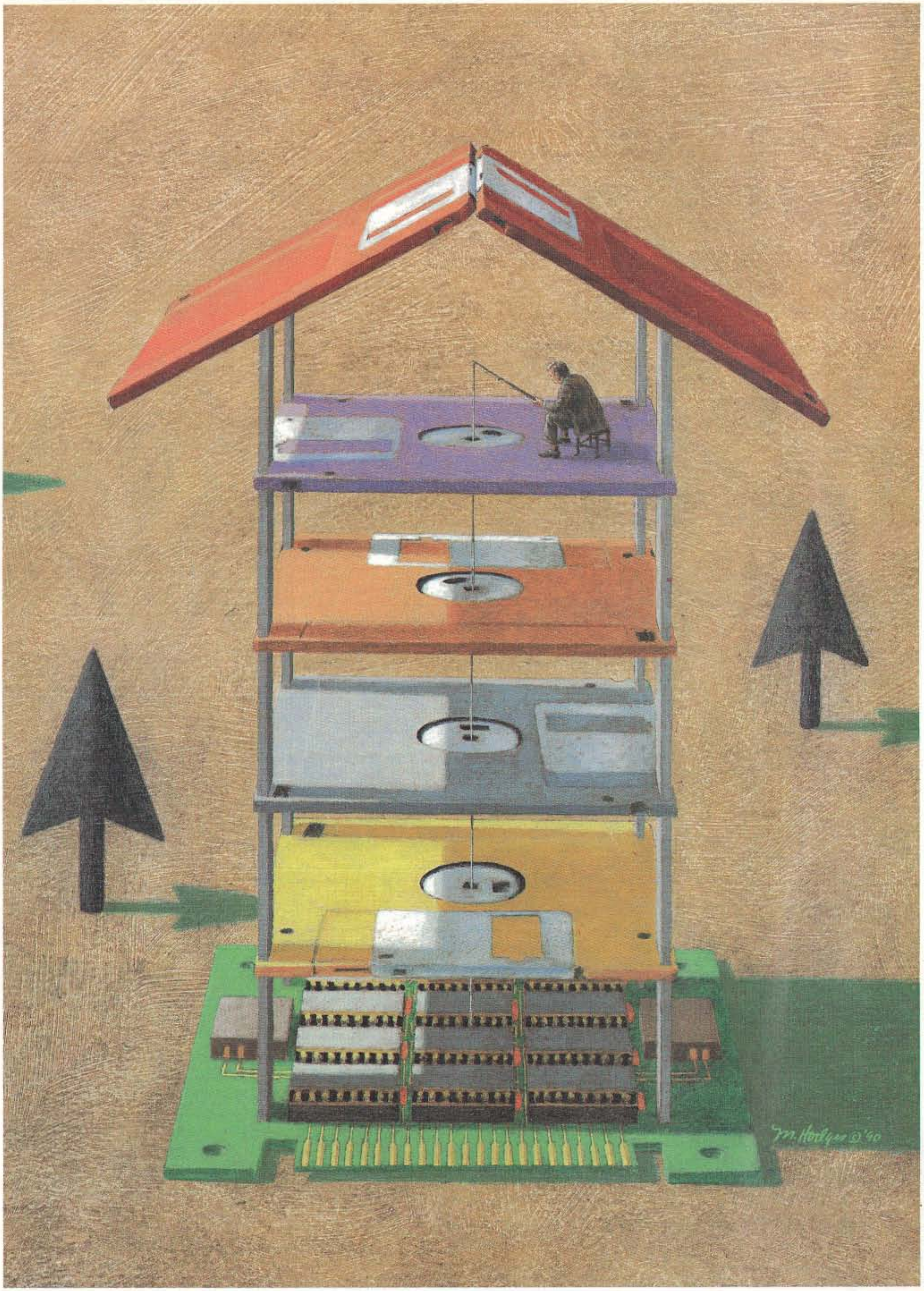


ILLUSTRATION: MIKE HODGES © 1990

Transparent and Portable

Applications architectures provide compatible access to incompatible machines

Mark L. Van Name and Bill Catchings

Sometimes a single solution can remedy several problems. Consider applications software. Users want programs that are easy to use and consistent across different machines. Developers want to produce bug-free software as efficiently as possible for as many machines as possible. And vendors want to provide a broad range of systems to attract as many buyers as possible. Applications architectures can satisfy the needs of all three groups.

An applications architecture is a set of tools for developing applications. By providing a consistent framework on different machines, it lets you get the most out of your equipment and training budgets. It's also a way out of the dilemma that plagues anyone who uses a computer: compromise.

Newer, faster machines promise improved productivity, but often at the cost of learning a whole new way of working. Existing systems let you work in familiar, comfortable ways, but often at the cost of living with less than optimal performance. An applications architecture solves this conflict. It ensures that your new system works the same way as your current one, or at least close enough so that the cost of learning the new system is bearable.

Such a framework also lets software developers make the most of limited resources. No one has the time or money to support all the interesting and commercially viable systems in use today. Even if you consider just personal computers, you must write software to run under DOS, Windows, OS/2, and the Mac OS to support the major platforms.

In addition, vendors develop applications architectures to bridge multiple environments. While they may strive for compatibility across product lines, time and changing technologies eventually force vendors to offer systems that are incompatible with previous hardware and operating systems. An architecture allows them to provide users and developers with a smooth migration path from the older to the newer systems.

Laying the Foundation

Most of the benefits of a good architecture stem from two basic features: transparency and portability. Not surprisingly, these terms have slightly different, albeit related, meanings for users and developers.

To a user, transparency is the degree to which a new system resembles the existing one. To put it another way, a new system is transparent if you can't tell the difference between it and your current system.

A transparent system should have the same look and feel as the system you use

continued

now. Its appearance, command structure, and menu structure—in other words, its user interface—should be familiar. Typing the same command, for example, should produce the same result on both systems, as should double-clicking on an icon.

The new system should also offer all the applications you currently use. Basically, if you can walk up to a display attached to a new system and feel as if you're working on the same old system, it is transparent.

To a developer, transparency means that a new system's structure is basically the same as the one on the previous system. The new system must provide a consistent set of abstractions, from the application programming interface (API) to the data, file, database, and network organizations. For example, application programs must be able to call memory-allocation, record-retrieval, and record-locking routines that work the same way on both old and new systems. (For a more-detailed discussion of APIs, see "Behind the Scenes" on page 215.)

Portability, while related to transparency, addresses slightly different concerns. For most users, the crucial part of a system's portability is its ability to handle existing data and procedures. When you walk up to a new system, you want to be able to load your working data—whether on disk, tape, or other media—and get down to business. If you have any automated procedures, which may range from keyboard macros to full-fledged programs, you want to be able to run them, too.

Portability is similar for developers, who need to be able to move current source code and development tools to the new system with as little hassle as possible. To meet this requirement, the new system must provide not only a consistent API, but also a consistent set of such development tools as text editors, compilers, linkers, and debuggers.

A complete applications architecture includes specifications and tools that address all these needs. It runs on several different platforms. It includes development guidelines, a consistent API for every aspect of development, and a complete set of development tools. Its user interface is consistent across systems, and, if it is successful, the resulting applications are also available on all systems.

Arguably, the most successful example of such a structure to date is the one offered by the Macintosh. Applications that follow Apple's user-interface and internal programming guidelines—so-called "well-behaved" applications—will run on any Mac, from the least to the most powerful, and with any size monitor and any Mac printer. They will also be relatively easy for experienced Mac users to learn, because they will have the familiar Mac look and feel.

Erecting the Framework

The Mac's applications architecture, like any other, consists of tools and specifications that address many issues. While no two approaches are the same, they all have to deal with the same basic problems.

To gain a broad view of the various architectures, we'll construct a framework within which to analyze them. Within this framework, we'll concentrate on the problems that the architectures must help a developer solve. If they solve those problems well, and if they provide a consistent user interface, then they will also meet the needs of the users.

An applications architecture is basically a set of tools with written guidelines for using them. The tools must be powerful enough to let developers build user interfaces that are consistent with the user interfaces of other products that follow the same approach.

The goal of these tools is to free you from having to deal directly with certain external elements. We'll take a look at each of these elements and the tools that these architectures must provide to deal with them.

Insulation Requirements

An applications architecture on any machine must deal effectively with the underlying hardware and system software. This is the area that usually gets the most attention, largely because it is the area where system vendors tend have the most problems.

Consider, for example, the problems of IBM. This giant firm has customers running such different platforms as its mainframes (with the firm's several different mainframe operating systems), System 38s, System 36s, System 34s, AS/400s, AIX RISC machines, and both DOS and OS/2 PCs. IBM is trying to unite some of these systems with its Systems Application Architecture (SAA), a mammoth task.

To let you work on such different hardware and operating-system combinations, an architecture must insulate you from the complexities of the underlying system. To do this, several key services must be provided.

One is memory management. All applications need to allocate and free memory, a problem that most systems address differently. The underlying architecture must provide tools for static and dynamic memory allocation, memory freeing, and a consistent way to deal with out-of-memory errors.

Another crucial service is task management. Applications must be able to communicate with one another, exchange data, and, ideally, spawn subtasks. To attain these ends, an architecture must provide good interprocess communication facilities, data-sharing tools (such as a clipboard), and a multitasking/multithreading facility. Sometimes, it must forbid certain facilities on some systems, such as multitasking on PCs, but then you must either write to the lowest-common-denominator system or abandon support for some systems entirely.

Another necessary function is hiding low-level aspects of the system or providing transparent ways to take advantage of those features that are present. Some systems, for example, have floating-point and graphics accelerators, while others do not. Ideally, an applications architecture lets programs automatically take advantage of those accelerators when they are present and remain unchanged on systems without them. Another approach is to provide a set of APIs that either passes calls to the accelerators or, when the system has none, emulates their function in software.

Similarly, as more and more systems begin to offer multiple processors, a good architecture must let applications benefit from them when they are present. At the simplest level, this means only hiding the existence of those processors from the applications. A better answer, however, is to provide tools, such as special compilers, that produce code that can take advantage of multiple processors when they are present.

Finally, such a structure must come with a set of rules for developing applications that distance themselves from the underlying system. These rules range from such simple ones as "Don't call the operating system directly; use the standard toolbox instead," to more complex ones, such as "Don't assume a given byte contains the most significant digit in any word." In essence, the applications architecture must become the underlying system. Writing portable applications means learning to live with the features of this "virtual system."

The Flexible Facade

Moving up a level in hardware, these architectures must let applications work with many different types of monitors.

The problems in this area depend in part on whether the system comes with text or graphics displays.

There are two basic problems with text displays: screen sizes and control codes. Applications must be able to work with different size screens so that text can expand to fill the available space. They also must be able to handle the different control codes demanded by displays from different manufacturers. The latter problem is particularly acute for ASCII display terminals, where a Digital VT220 uses different display codes than a TeleVideo 925, which differs from the next, and so on.

Although these problems are answered in different ways, there are just two basic approaches. One is to provide a template file that contains a set of generic display commands and mappings for those commands for different terminals. This is the approach that Unix typically uses, with its `Termcap` and `Terminfo` files. The other approach is to use an insulating software layer. That layer can be anything from a simple receptacle for display drivers, such as those supported by Windows, to a complete set of controlling procedures, such as the Mac's QuickDraw software.

The notion of an insulating layer of software also works for graphics displays, although the problems are more complex. Graphics displays differ in everything from size to resolution to the ways programs must control them. The best solution is to have a set of controlling procedures and an accompanying set of development specifications, such as the Mac's QuickDraw or the X Window System (referred to as X Window for the remainder of this article).

You can, of course, just write drivers for each different graphics standard. This has long been the DOS approach. The differences between the results of this approach and the results of having a layer of graphics software are, however, profound.

Hook a PC up to a high-resolution 21-inch monitor, for example, and most PC applications will still run in 80-column by 25-row mode or 640- by 480-pixel VGA mode, wasting most of the screen's size and resolution. The monitor may come with drivers for certain key applications (typically desktop publishing and CAD/CAM programs), but most programs will run as if they are on a 12-inch display.

Now attach a 21-inch monitor to a Mac. Nearly all Macintosh applications will instantly work with it. At worst, you only have to enlarge their windows. The screen's size and resolution don't matter, because QuickDraw deals with those features at a level below the applications. In fact, QuickDraw goes so far as to let the Mac work with multiple monitors simultaneously, all with no programming effort other than following the development guidelines.

X Window defines a similar set of insulating functions for Unix graphics workstations. Applications that are designed to use these functions can run on any X Window workstation without the specifics of the different displays causing problems.

Hook a PC up to a high-resolution 21-inch monitor and most PC applications will still run as if they are on a 12-inch display.

X Window can also take advantage of the hardware features of a particular display system. If, for example, the display hardware can draw a filled polygon on the screen, X Window maps that feature to one of its own functions. (X Window itself calculates the pixels to activate for display systems that don't have such a polygon-fill function.) X Window applications look basically the same on different displays, no matter how each screen draws pixels.

Entrances and Exits

Keyboard specifics can also be a problem. The easiest way to handle that problem, of course, is to force every keyboard to emit the same codes. That's essentially the answer for PCs, where keyboards have to be PC-compatible for anyone to buy them.

Another approach is to define a basic set of keycodes for the architecture and a way to provide drivers that map the codes from various keyboards to the basic ones. The coming standard for a Streams-based Unix terminal driver will include this type of abstraction. This keyboard driver lets keyboards with different national key sets and layouts work with Unix applications.

Printer codes can also cause difficulties. Historically, applications have required special drivers to support the various printers that are popular for a specific machine. This approach, while expensive, at least lets applications take full advantage of the features of different printers.

To minimize development costs, many vendors built their own internal printer-template files. These files mapped the control codes of different printers to a basic set of printer functions. The problem with this approach, of course, is that the basic set has to be very rich in features or it won't be able to take full advantage of some of the printers.

Sometimes printer pseudostandards, such as the Xerox Diablo 630 or the Hewlett-Packard LaserJet, emerge. These pseudostandards typically are the control codes of printers that became so popular that many other printers emulate them.

Today, the trend is toward sophisticated page-definition languages. A PDL provides you with a standardized way to define the appearance of a printed page. A PDL interpreter then turns PDL commands into something that a particular printer can understand. By far the most widely used PDL is PostScript.

Grist for the Mill

The final piece of the external environment of any program is its data. There are several aspects of data that can vary from one system to another, including its machine representation (e.g., which byte in a word contains the most significant bit), file format (e.g., flat or indexed file), and network location. While we won't go into detail on these topics, an applications architecture must nonetheless address them.

Further, as more and more applications rely on databases for their data, the architectures must provide insulating layers for database functions. Apple's CL/1, for example, is a standard toolbox that lets you work with many different types of databases on many different, possibly remote, systems.

Ergonomic Engineering

The sum of all these insulating layers of software is a set of programming abstractions, or tools, for building applications. Programs developed with these tools will work in many external environments. That's a great step forward, but it's not

continued

the end of the journey.

The next step is to ensure that all applications employ the same user-interface style. Key issues here include consistent visual layouts, the way in which you work with the keyboard (and, typically, a mouse), and menu and command structures.

An architecture should do two basic things to help create applications with "acceptable" user interfaces. The first is to provide a set of specifications that defines exactly what "acceptable" means: Developers must have a goal. The other is to provide a set of tools that makes it easy to reach that goal.

The Mac's Toolbox is one example of such tools. A newer and, according to most reports, more powerful answer is the NeXT Interface Builder, which helps build consistent user interfaces quickly.

Early user interfaces were simple command-line interpreters like the one in DOS. These interfaces left you on your own, forcing you to learn many arcane operating-system commands and different working styles for each application.

Then the Mac popularized the graphical user interface (GUI), a system based on graphical icons, pull-down menus, and other devices designed to free you from having to memorize lots of commands. The Mac's interface standards also gave a standard look and feel to Macintosh applications.

Today, GUIs are all the rage. Windows and NewWave are vying for the GUI title on PCs, with such other players as GEM also in the fray. OS/2 has its own GUI, the Presentation Manager.

The Unix world is perhaps the most complicated one currently, with such major GUI contenders as the Open Software Foundation's Motif and Unix International's Open Look, as well as NeXT's NextStep, and others. The goal of all these systems is to free users from the need to learn cryptic Unix commands, so that Unix can become popular with many of the same people that today work happily with Macs. (For further details on GUIs and other user interfaces, see "From TTY to VUI" on page 205.)

Building Overhead

If by now you're thinking that applications architectures sound like a lot of software, you're right. Complete ones include a substantial amount of code and documentation, and they have some costs as well.

Perhaps the most obvious cost is performance overhead. If you want to squeeze the last drop of performance from a system, you write directly to the hardware, preferably in hand-crafted assembly code designed to take advantage of every feature of the processor and display. These architectures are at the other end of the spectrum: They cover every aspect of the system with a thick, CPU-draining blanket of software.

The standard argument in their favor, however, is that the results justify the performance costs. Besides, ever-faster hardware will handle the CPU requirements easily. We support that argument, but we also think it's important to realize that these architectures have a considerable performance overhead. The more sophisticated the applications architecture that you want to embrace, the more powerful the system you are likely to need.

These architectures can also be complex. The learning time for DOS developers, for example, is far less than the learning time for Mac developers. This is a problem. The best solution to date seems to be using higher-level toolboxes, such as NeXT's Interface Builder, that hide the nitty-gritty under another layer of software.

A final potential cost is in innovation. No architecture can cover everything; when the next great advance in, say, user interfaces comes along, a good one can actually hinder creativity. The only answer here is to design them to grow easily, so that things like user-interface style can evolve to reflect new technologies.

Expansion Plans

Despite the costs, applications architectures are clearly hot. In fact, this is one area where it's easy to make general predictions with confidence.

For one thing, you can expect each of the major vendors to standardize on one applications architecture or, at most, a few. IBM and Digital Equipment Corp. (DEC) are already doing it, and most Unix system vendors are either already standardizing or ready to do so as soon as the Open Software Foundation versus Unix International conflict is resolved.

Another safe bet is that object-oriented programming will play an increasingly important role. Object-oriented systems let you define abstractions that have well-known specifications and are well insulated from the outside world. Objects are the latest and greatest ways to express abstractions in programming, and that's much of what these architectures are all about. The object-oriented approaches of the NeXT system and HP's NewWave are almost certainly just the first of many.

You can also expect to see more high-level cross-system development tools, from large sets of toolboxes built around objects to still-higher-level fourth-generation languages. (For a discussion of some of the various cross-system development tools available, see "Bridging Troubled Waters" on page 225.)

Finally, as the industry learns more about how to build multimedia systems, you can expect to see user interfaces and other aspects of these architectures that take advantage of those systems. Voice and video are likely to become far more common in the future as vendors strive to make computers more accessible.

The Ground Floor

Most of all, you can expect applications architectures to continue to rise in importance. Consistent approaches have proven benefits.

Look, for example, at DEC's success in recent years. While DEC did not have a stated applications architecture a few years ago, it did offer the same basic machine (VAX) and network (DECnet) architecture from its smallest system to its largest. IBM, by contrast, had to support many different system types. The result was a huge increase in DEC's user base, often at IBM's expense.

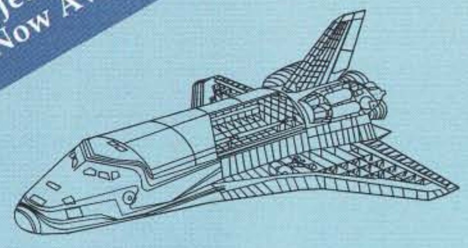
Even DEC, however, has had to bow to the performance of other machine architectures and now offers workstations based on MIPS Computer's RISC chips. These workstations are not compatible with DEC's VAX products, so now the company is building an applications architecture called Network Applications Support (NAS) to link these two systems and Unix workstations, DOS PCs, and Macs as well. (For a comparison of IBM's and DEC's applications architectures, see "Blueprints for the 1990s" on page 237.)

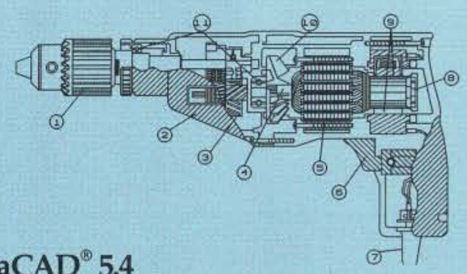
Over the next few years, you can expect other architectures to join the Mac's as leaders in the personal computer arena. Vendors of other large systems will also strive to offer total architectures on their systems (see the text box "An Open Approach" on page 246). Who will come out ahead is anybody's guess. The only sure thing is that increased portability and transparency will be a plus for everyone who uses desktop computers. ■

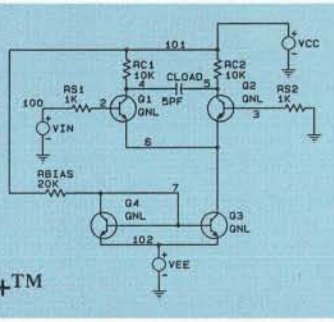
Mark L. Van Name and Bill Catchings are BYTE contributing editors. Both are also independent computer consultants and freelance writers based in Raleigh, North Carolina. You can reach them on BIX as "mvanname" and "wbc3," respectively.

HP LaserJet IIP & IID Version Now Available!

	Plotter in a Cartridge™	HP 7475A Plotter	Software Plotter Emulation
AutoCAD® Release 10	15 seconds	3 minutes 17 seconds	1 minute 2 seconds
VersaCAD® 5.4	49 seconds	9 minutes 45 seconds	3 minutes 11 seconds
Schema II+™	17 seconds	5 minutes 15 seconds	2 minutes 13 seconds







Compared to Plotter in a Cartridge, everyone else is behind the times.

For fast HPGL output, there really is no comparison. Pacific Data Product's *Plotter in a Cartridge*™ is up to 100 times faster than pen plotters or PC-based software emulations.

Simply plug it into your LaserJet Series II or Canon LBP-8II printer and it's ready to print precise, high-quality graphics. And we also have a version for the HP LaserJet IIP and IID printers. *Plotter in a Cartridge*™ is compatible with all of the major CAD/CAM, engineering and graphics software packages.

For your nearest authorized dealer, or for more information on our full line of laser printer enhancement products, call Pacific Data Products at (619) 552-0880.

Pacific Data Products–Plug into Power

PACIFIC DATA PRODUCTS

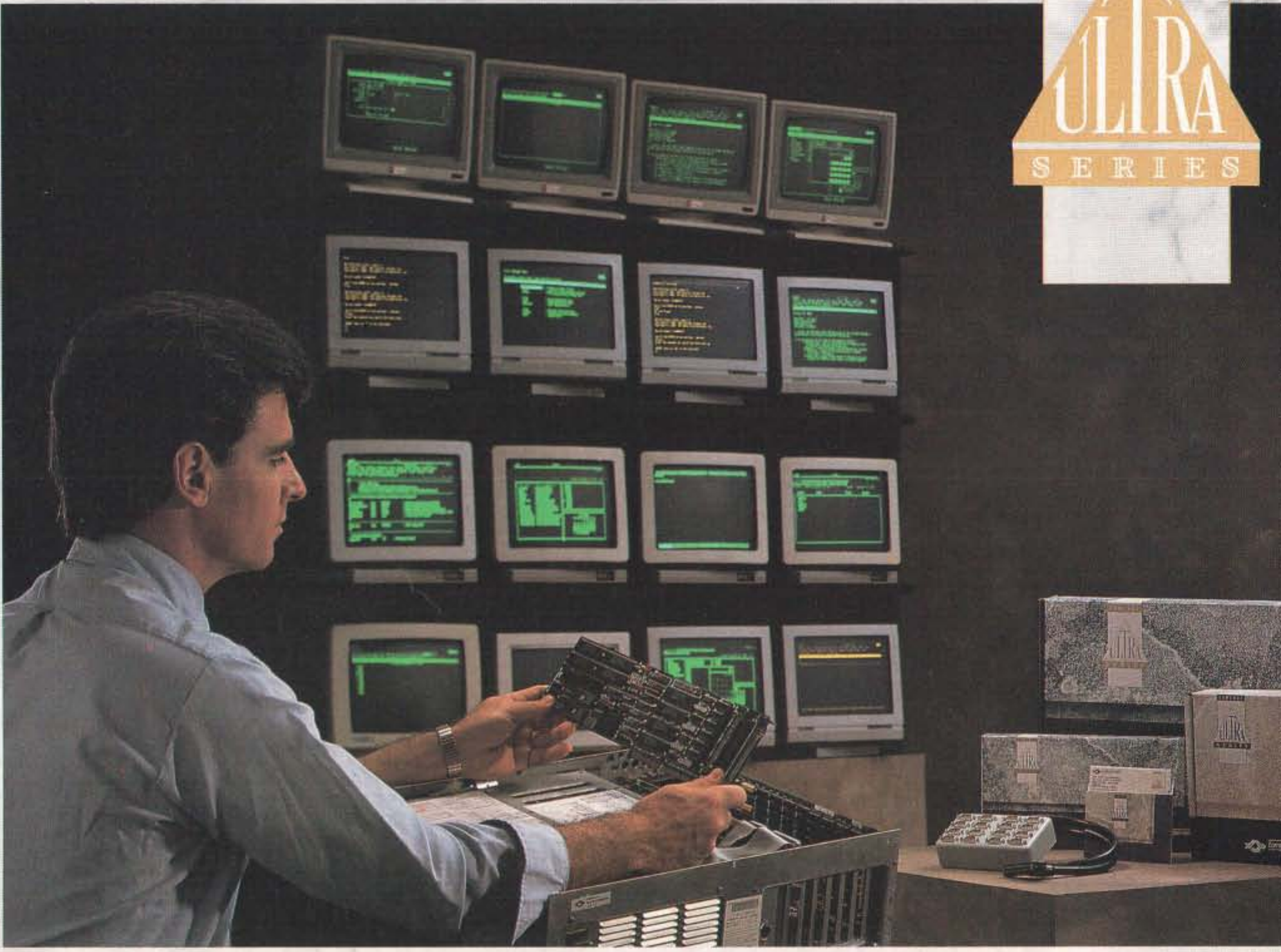
9125 Rehco Road,
San Diego, California 92121
(619)552-0880, Fax (619)552-0889

Circle 210 on Reader Service Card (DEALERS: 211)

Using 16 Ports Is Easier Than Ever

COMTROL

ULTRA SERIES



You told us what you're looking for from your multiuser communication controller. We listened and gave you exactly what you asked for. The ULTRA 16 and ULTRA 8 — designed to make your life easier.

Now you can have…

- ▲ A Powerful 80286 Processor
- ▲ Streams Drivers
- ▲ Field Upgradable From 8 To 16 Ports
- ▲ New "Quick Connect" Cabling
- ▲ A Universal Interface Box and "Dual Lock" Mounting
- ▲ Easy To Install Drivers For SCO XENIX System V, SCO UNIX System V, Interactive 386ix, IBM AIX, Sun OS, IBM OS2 and PC-DOS
- ▲ Transparent Print
- ▲ Multiple Sessions
- ▲ Easy To Use Documentation

When you need a basic multiuser communication controller, give our HOSTESS SERIES a try. Count on our people to give you the support and extra effort you deserve and have come to expect from us since 1982.

Call Us Toll Free
800-9-COMTROL

Comtrol Corporation
A Control Systems Company
2675 Patton Road
P.O. Box 64750
St. Paul, Minnesota 55164
(612) 631-7654 • (800) 926-6876

Circle 71 on Reader Service Card

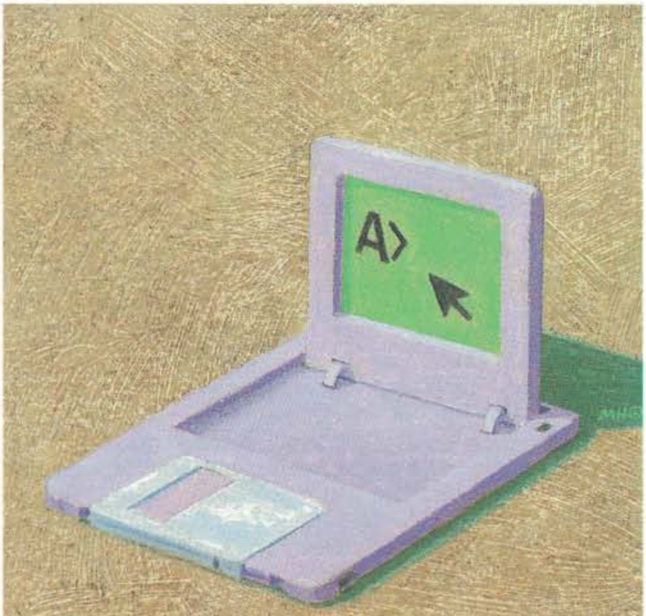
From TTY to VUI

As computers become more complex, using them becomes easier and easier

Frank Hayes

What makes a good user interface? That is not a simple question. Designers have been struggling for decades to create architectures that let you get the most from your software. There are questions of priorities. Should the user interface maximize performance for experts or shorten the learning curve for beginners? Is safeguarding data more crucial than efficiency? And which should take priority: flexibility or throughput?

Not surprisingly, the quality of a user interface depends on the level of technology represented in the underlying hardware. The first interactive computer systems communicated with you through teletypewriters (TTYs)—character-based terminals that could accept only typed input and could print only on paper, one character after another. As technology improved, video display terminals (VDTs) became widely available. These "glass TTYs" could position a character anywhere on the screen. They quickly became the norm in computing. Then came high-resolution graphical displays that could support graphical user interfaces (GUIs), complete with mice.



In the Beginning Was the TTY

The original interactive user interface was the command-line interface. The most familiar CLI today is probably the DOS A> prompt, but the heritage of CLIs goes further back than the IBM PC. They came by way of the TTYs that served as the first terminals for mainframes.

TTYs had a bottleneck problem: Each command you typed had to be sent to the computer across a relatively slow serial link, and once the command arrived, the computer had to decode it. A typical CLI had to minimize the amount of information making its way from the TTY's keyboard to the mainframe. This is part of the reason why all CLIs have inherited a tendency toward short and cryptic commands. The only way around the bottleneck was to limit the amount of information that had to pass through it. Thus, in those early days, every keystroke counted.

TTYs were limited in what they could print out as well. A TTY printed one character at a time, typewriter style. As the TTY gave way to the VDT, something new was added: the ability to alter the position of the cursor. That made it possible to print information anywhere on the screen. Using special keystrokes and a character-based VDT, software allowed you to move a cursor around the screen. You could go back and correct mistakes and update information. It's hard to grasp today what a profound improvement the electronic VDT was over the paper-based TTY.

continued

It's even harder to grasp that the "glass TTY" still defines the limits of CLIs, even on high-powered PCs. Although desktop computers have all but eliminated the bottleneck between the computer and the screen, character-based PCs behave as though the bottleneck still exists. CLI commands are still short and cryptic, and every single keystroke still counts. With a CLI, one wrong key can wipe out a day's work. However, CLIs remain popular because they work with almost any kind of operating-system architecture that can accept or print one character at a time. But they certainly show their age.

Fortunately, when desktop computers eliminated the CPU-to-display bottleneck, they also made graphics practical, and with them, GUIs.

The Mac Standard

The Macintosh user interface was the first GUI to appear on a popular desktop computer. It became a model for almost all the GUIs to follow. By comparison to the one-character-in, one-character-out simplicity of CLIs, GUIs are immensely difficult to program. The goal, however, is to make life easier and more productive for users. Three standard features distinguish almost any Macintosh screen from a non-GUI screen: a mouse pointer, a menu bar, and one or more windows (see photo 1).

The mouse pointer, which you move around the screen by moving the Mac's one-button mouse, is typically an arrow. A program can change it to one of a number of graphical icons, however, each with its own meaning. For example, to indicate that you're supposed to wait while the computer does its work, the software will typically change the pointer to a watch.

There are several standard mouse actions. Clicking selects an item or an action, double-clicking simultaneously selects an item and starts an action, and dragging moves objects on the screen or selects groups of objects.

The menu bar runs across the top of the screen. Clicking on an item on the menu bar causes the menu to drop down. Each menu item is associated with an action, which you can select by clicking on it. You can also select some menu items by using keyboard equivalents (i.e., using key-based commands instead of the mouse and menu).

Other menu items pull down submenus. A submenu appears to the right of the original menu. The items on the submenu can themselves have submenus, so it's possible to work your way deeper and deeper into the command structure and see all the menus as you do. Any item, no matter how deep in the menu structure, can have a keyboard equivalent, which would make it unnecessary to go through the entire menu structure to initiate the action.

A window is a rectangle on the screen that lets you work within a program. On a Mac, you may be able to move the window around on the screen, change its size and shape, open it to fill the screen, close it entirely, or change how much of its contents shows. Windows can also contain buttons, menus, sliders, and other objects.

The "glass TTY" still defines the limits of CLIs, even on high-powered PCs.

Outside the window, there can be other icons, such as disk drive icons or a Trashcan. Just as every menu item is associated with an action, every icon is associated with an object, whether that object is a file, a program, a group of files, or a storage device such as a disk drive or a network server.

Apple has made an extraordinary effort to control the Mac GUI, with guidelines that aren't merely suggestions—they have the force of law. The payoff has been that Macintosh applications all look and act very much alike—a consistency that, until the Mac, was almost nonexistent in software.

But the Mac's reputation for ease of use consists of equal parts reality and myth. While almost all Mac applications are similar, they can require extraordinary calisthenics to operate. A mouse-click is used to select *and* deselect items. Some software requires complex user actions, such as triple-clicking or dragging while a key is held down. And with keyboard equivalents, there are often several different ways to accomplish the same thing.

What's wrong with that? It's not consistent—and it's certainly not simple to learn. Jef Raskin, the Apple designer who originally created the Macintosh project and gave the machine its name, argued that every action should always have the same result, and that every result should have just one action associated with it. For example, there should be only one way of erasing a file.

Raskin's argument is compelling: Efficiency and ease of use come from habit, and if you have one way of erasing a file, you'll become very fast at erasing files that way. The GUI designer's task, Raskin believed, was to find good, easy, efficient ways for you to perform your work. Once those ways have been developed, *all* software should follow them.

Needless to say, Raskin's design changed after he left the project, and the Mac you see today bears little resemblance to his original plan. The result is a plethora of ways to do almost anything on a Mac—which makes it flexible, but much more complex than its reputation implies.

Although the Mac has demonstrated in business settings that it is easier to learn than CLI-based systems, it's still a far cry from a truly easy-to-use system. This is part of the reason that, while Macintosh software was a huge improvement over the software available in 1984, it has not catapulted the Mac into spectacular success.

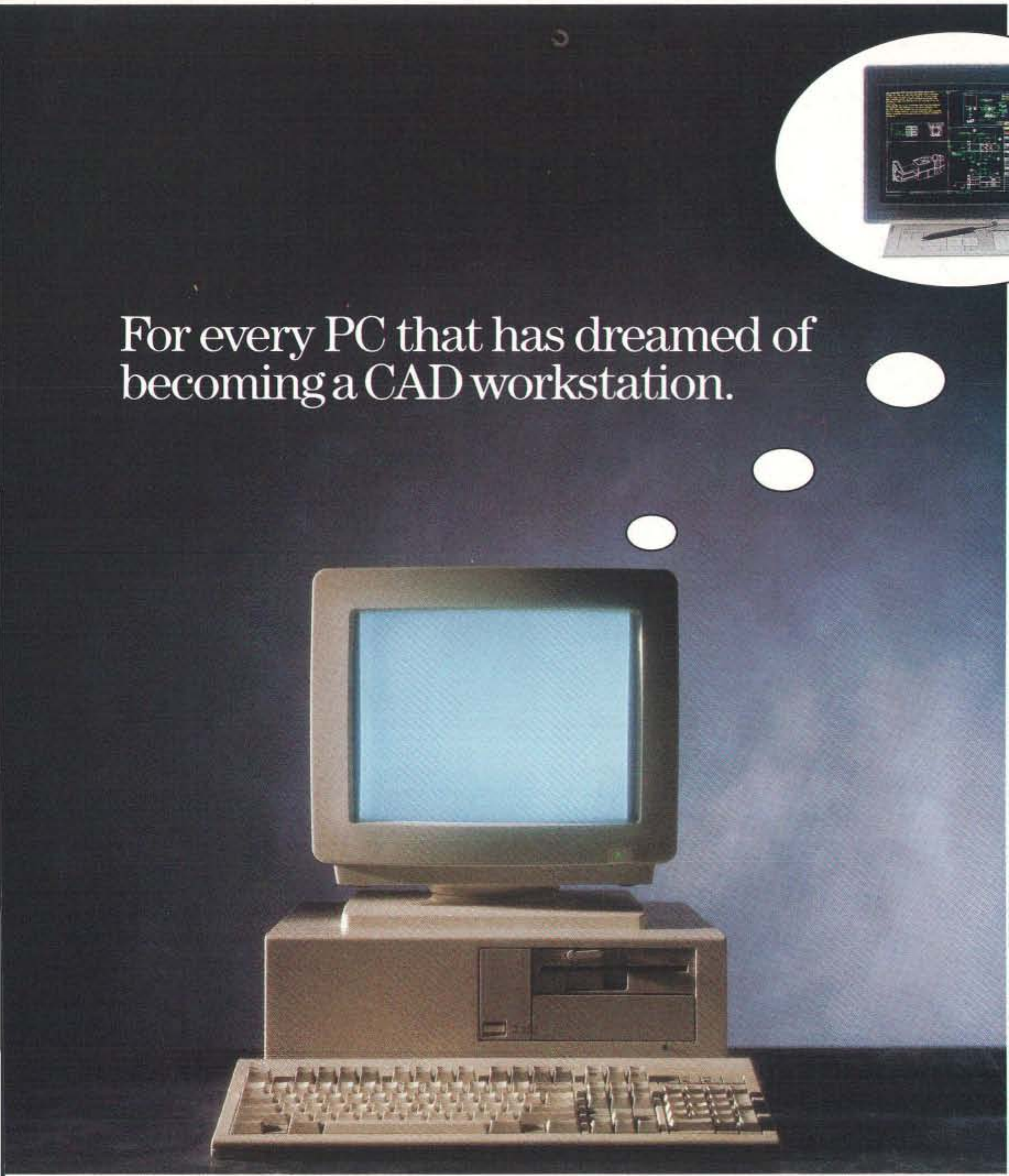
The Macintosh is certainly not a failure—its consistency across applications is unsurpassed, and Apple's programming guidelines produce software that rarely has trouble coexisting. (By contrast, you often find yourself playing "TSR roulette" when you try to add yet another pop-up program to your collection of DOS utilities and drivers.) And if the Mac hasn't kept the faith of Raskin's original, friendly user-interface design, it still seems like the Holy Grail of interface design compared to DOS.

DOS Opens a Window

While the Macintosh was originally designed with a GUI, the PC was designed with CLIs. PCs get their CLI from a file called COMMAND.COM, which is actually a program that runs when no other programs are running. COMMAND.COM provides the A> prompt and executes simple built-in DOS commands such as ERASE, COPY, and DIR. COMMAND.COM also loads and executes applications and batch files.

Early versions of DOS required that the original COMMAND.COM be in place, but more recent versions allow you to replace COMMAND.COM with other command interpreters, including GUIs. However, there's a fundamental problem in adding a GUI to a PC: DOS lacks many of the building blocks of a GUI,

continued



Call for your FREE HP ME10d videotape. 1-800-526-1036.

A workstation CAD package can give you all the functionality you need. But you work on a PC. And you're concerned that it's putting limitations on your designs.

Hewlett-Packard has a better way.

HP ME10d. A mechanical design and drafting system that brings workstation performance to your PC.

Our videotape will show you that it only takes a few steps to complete complex, precise designs. This added efficiency can be yours with a minimum of training. No matter what system you're using today.

HP's ME10d works with ME30 and other industry solutions on IBM, Compaq, and HP Vectra PCs. It can easily accept existing files and designs can be output to other CAD/CAM applications.

With HP's ME10d you'll get the complete PC CAD solution. And all the assurances that come with the Hewlett-Packard name. Engineering expertise. Commitment to standards. And reliability.

Call **1-800-526-1036.** Get the video. And get more from your PC.

There is a better way.

HEWLETT PACKARD

Circle 136 on Reader Service Card

GUI COMPARISON

These five leading GUIs show their strengths in different areas. The Macintosh is highly consistent across applications; Windows and PM offer SAA compatibility and multitasking; and Open Look and Motif operate through networks but tend to be slow.

GUI	Macintosh	Windows	PM	Open Look	Motif
Operating system	Macintosh	MS-DOS	OS/2	Unix	Unix
Multitasking	No	Yes	Yes	Yes	Yes
Networking GUI	No	No	No	Yes	Yes
File manager	Internal	Internal	Internal	Internal	External
Consistency across applications	Very good	Good	Good	Not available	Not available
Graphics performance	Good	Good	Good	Slow	Slow
Menu style	Pull-down	Drop-down	Drop-down	Pushpin	Drop-down
CLI available	No	Yes	Yes	Yes	Yes
Underlying standards	Macintosh	SAA	SAA	X Window	SAA, X Window
Software base	Large	Moderate	Small	Nonexistent	Nonexistent
Available	Yes	Yes	Yes	No	No

such as a windowing system, mouse support, and screen drivers, to handle objects that appear, disappear, change size, and move. Creating a windowing system for DOS requires building all these elements and then piling them atop DOS's command-oriented structure. The result tends to make PC-based GUIs memory-hungry and slow.

Despite the basic problems, there have been several attempts to bring windowing environments to DOS. The most notable have been GEM from Digital Research, Inc. (DRI), Microsoft Windows, and Quarterdeck's DESQview.

GEM was originally designed as a full mouse-and-menus windowing system. It ran into legal trouble with Apple very early, and DRI had to make significant changes to GEM's desktop. Windows was another early contender that ran into trouble with Apple. Microsoft's solution was to sign a license for some of the Apple technology.

But other problems stood in the way of the success of Windows and GEM. Users complained that both systems were slow and required too much memory. In addition, both GEM and Windows require that programs be designed explicitly for them, thus slowing their acceptance. GEM finally found a niche as the shell for Xerox's Ventura Publisher desktop publishing software. It has taken years for Windows to build a significant following.

While DESQview qualifies as a windowing system and supports a mouse, it was not designed primarily as a Mac-competitive GUI. Instead, DESQview was intended to allow several ordinary DOS programs to run simultaneously in separate on-screen windows. As a result, it became the first successful multitasking system for the PC, although it doesn't really fall into the GUI category.

But Windows is a GUI, and a substantial number of programs have now been designed to work with it. Like the Mac's GUI, Windows and its visually similar cousin, OS/2's Presentation Manager (PM), use a mouse pointer, a menu bar, and movable windows. However, some superficial differences quickly become apparent.

For example, menus drop down immediately when the mouse points to an item on the menu bar. (Windows has drop-down menus as opposed to the Mac's pull-down menus.) The windows themselves share only some of the standard features of Mac windows. For example, you can move a Windows or PM window by its title bar, but you can change its shape by dragging any of the other three sides.

Windows and PM also have boxes to *minimize* a window, allowing a program to continue running in the background and remain visible on-screen only as a small icon (see photo 2). That feature—part of their support for multitasking—is their most recognizable advantage over the standard Macintosh GUI.

But something else sets Windows and PM apart: They are designed to conform to IBM's Systems Application Architecture. SAA is part of IBM's plan to bring a level of standardization to some of its operating systems, from mainframes to PCs. The fundamental idea is to design an architecture in which the same software can be used on a terminal connected to a mainframe, a workstation connected to a minicomputer, and a desktop microcomputer—with only minimal changes to support the wide range of hardware involved.

That task is difficult, because the lowest common denominator, character-based terminals, does not support graphical displays or mice. To allow software to run on both terminals and PCs with GUIs, SAA mandates that every menu item or mouse-based action in an SAA-compliant system must have a keyboard equivalent.

As a result, there will be a certain level of consistency across all SAA applications. Function key F1, for example, is always the help key under SAA (a standard that has been picked up by many non-Windows and non-PM applications). And most Windows applications, for example, generally function like other Windows applications.

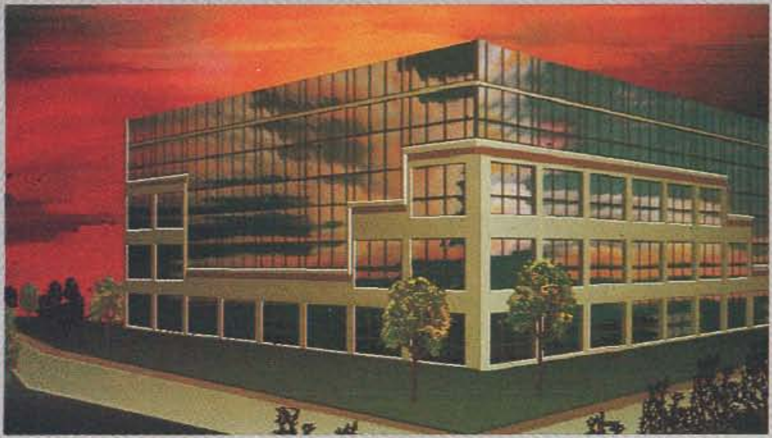
However, Microsoft's style guidelines are not nearly as rigorously enforced as Apple's. Given the PC's history of incompatibilities, it's hard to believe that Windows and PM will ever achieve the level of consistency of Mac software.

Windows and PM offer some advantages over the Mac, however, including the ability to minimize a window, but neither Windows nor PM offers a GUI that is as smooth or attractive as the Mac's, or as consistent. Also, Windows and PM, with their mandatory keyboard equivalents, stray even further than the Mac from the principles of ease of use. Ultimately, even more than the Mac does, Windows and PM may suffer from programmers who would rather substitute a windowing system for careful, friendly program design.

X Marks the Spot

Unix poses its own problems for GUIs. Like DOS, Unix was designed as a character-oriented system; any graphical elements must be built on top of the original system. But Unix has another problem: Unlike DOS or OS/2 systems, in which the display is closely tied to the CPU, a Unix system can have a display terminal

continued



If these images didn't catch your eye, then why are you reading this ad?

Images that leap out at you, especially in a magazine like this, have to be powerful. And whether you need to present your business information more effectively or you want to expand into multi-media, you need strong visuals. Together with Truevision, you can develop that power for presentations, CAD, training, video production and more. And it's easier than you think. You can bring photo-realism and multi-media to your presentations by using a TARGA board with compatible software and peripherals from over 200 companies.

With a TARGA videographics board and your PC®, XT® or AT®-class machine, you can capture images in real-time from a video source, merge them with other images or add text and graphs, even create stunning broadcast-quality animations, and then output the result to video, tape, slides or paper prints. That's how to maximize your presentation efforts into multi-media.

Truevision videographics cards are ready for you today. Contact us at **800/858-TRUE** for more information, or visit your local Authorized Truevision Reseller for a demonstration. We'll show you how to visualize your data in a way that no one else can.

TRUEVISION

7340 Shadeland Station, Indianapolis, IN 46256
INTERNATIONAL: Canada 416/499-9400 France 33-952-13-6253 Italy 39-2-242-4551 Switzerland 41-1-825-0949 U.K. 44-1-991-0121
West Germany 49-89-612-0010 Other 617-229-6900

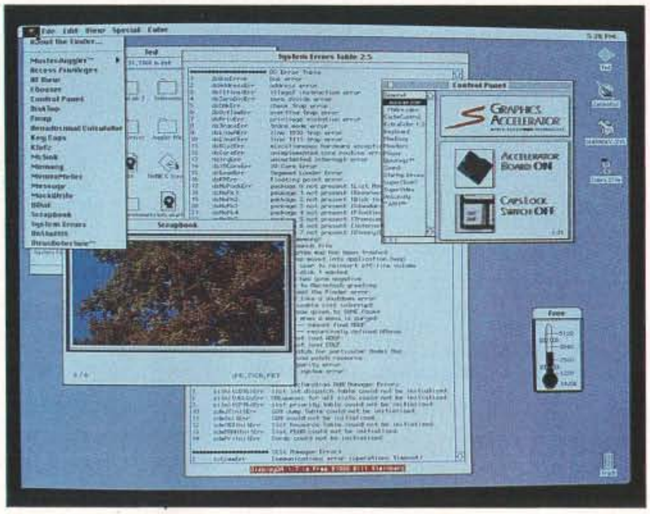


Photo 1: *The Macintosh interface contains all the elements of a typical GUI. The pointer (upper left) lets you make selections and position the cursor. Menus supply you with choices among a range of actions. Windows display the output of programs.*

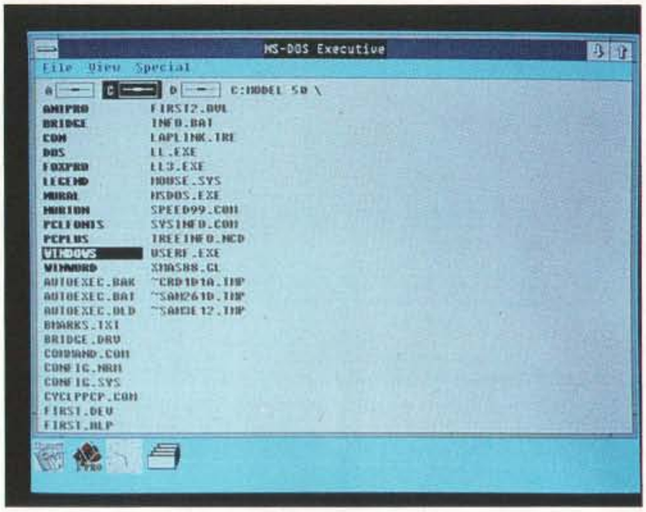


Photo 2: *The minimize feature of Windows and PM keeps your display uncluttered while you run multiple applications. Programs running in the background are represented by their icons, rather than by an output window.*

that's far from the central computer. It's the bottleneck problem all over again: How can you send large amounts of graphical information through a conventional communications link?

The commonly accepted solution is MIT's X Window System (referred to as X Window for the remainder of this article). X Window is a standard way of describing graphically oriented displays and sending the information from one X Window system to another. X Window also provides the ability to send keystrokes and mouse-movement information, so you can interact fully with the program. X Window doesn't completely solve the bottleneck problem, but it's a great improvement over sending a GUI display to a terminal one pixel at a time.

However, X Window is not a GUI. You might say it's just a graphical communications interface. Several X Window–based GUIs have been built (including proprietary systems, such as DECwindows, which runs only on DEC computers). But the two X Window–based Unix GUIs that promise to become the most widespread are Unix International's Open Look and the Open Software Foundation's (OSF) Motif.

Open Look was designed by Sun in close association with AT&T. In fact, it was originally designed to be *the* GUI for the new version of Unix (System V release 4), which is scheduled to appear this year. However, Open Look has both technical and political peculiarities. It can use some of the X Window System, but it also depends heavily on Sun's own operating-system features.

One of the reasons for a hybrid approach was X Window's notorious slowness in updating some screens. This slowness is more than a minor annoyance. It's the most obvious characteristic of many X Window implementations. Users complain that they can move a mouse and wait seconds before the onscreen mouse pointer moves. However, a new version of X Window was recently released, and it's said to be much more responsive.

Another reason may have been Sun's long investment in its own non–X Window GUIs. The Sun alliance with AT&T was directly responsible for the creation of Open Look's main competitor, Motif, which *is* fully X Window–based.

As you'd expect, Open Look resembles the Mac and PC windowing systems. The usual windows and mouse pointer are there, and, as with Windows and PM, a window can be reduced to an icon while its program continues to run.

But Open Look has some different features as well. You can move a copy of a menu around on-screen, for example, or hold it in position with a pushpin (see photo 3). Even more significant is Open Look's mouse. It has three buttons, each of which has a specific purpose. The left button is for selecting items from menus; the middle button is for moving and resizing windows; and the right button is for pulling up so-called *invisible* windows and menus, which appear separately from any menu bar.

Open Look's unusual use of the mouse is both its greatest weakness and its greatest strength. If you're accustomed to using other GUIs, the three-button approach is unfamiliar. But it's also much more consistent—a particular mouse button *always* serves the same function. As a result, although the learning curve is somewhat steeper, some users say Open Look is ultimately much more efficient than other GUIs.

OSF/Motif has its own political and technical history. OSF was formed by several Sun competitors who feared that Sun's close relationship with AT&T would produce a version of Unix that would be especially well suited to Sun's workstations—giving Sun a head start in getting products to market. OSF's first project was a competition to design an X Window–based GUI that would compete with Open Look. The result was Motif (see photo 4)—a blend of the look of Hewlett-Packard's NewWave, the feel and behavior of OS/2's PM, and the toolkit from DEC's DECwindows system.

Motif looks very much like Windows or PM, except that it has the characteristic three-dimensional look of NewWave. It works very much like the PC-oriented GUIs and has the ability to minimize a window. However, Motif doesn't come with its own file manager—the portion of the GUI that actually allows you to copy and delete files. Some current implementations of Motif (including The Santa Cruz Operation's Open Desktop) use IXI's X.desktop as the file manager. However, X.desktop can be jarring to some users, since it and Motif don't

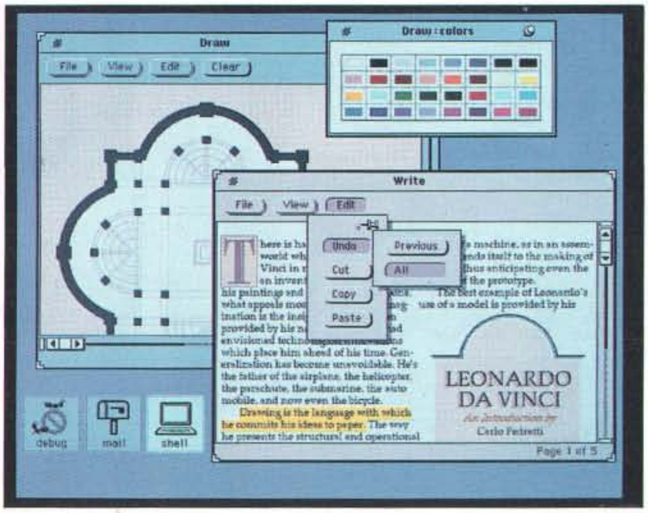


Photo 3: *The Open Look pushpin menus let you position a menu wherever you like on the screen.*

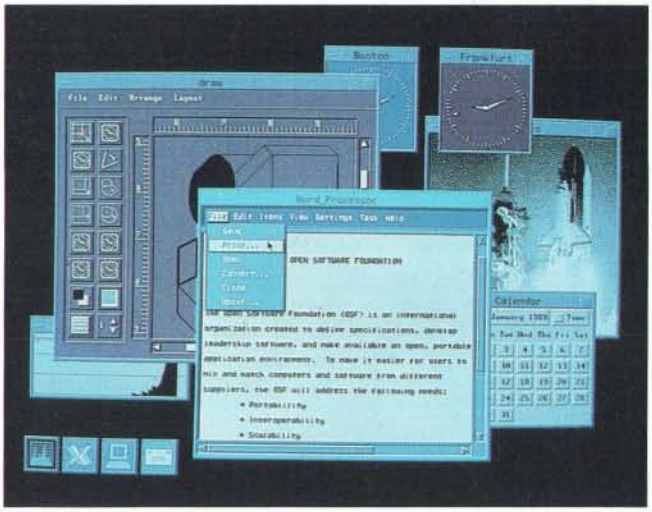


Photo 4: *Motif features a distinctive three-dimensional look, while conforming to the X Window System and IBM's SAA interface standard.*

share the same visual style.

Both Open Look and Motif have extensive specifications for conforming to a standard style, but it's too soon to tell whether either system will approach the Mac's consistency across applications. In fact, both GUIs have just been introduced, although several different software vendors have demonstrated their products using early versions of the interfaces. At the moment, Open Look seems almost ready to go. Meanwhile, Motif, with its conventional use of X Window and the mouse, seems to be a more familiar and popular choice, but it isn't yet ready for users.

With either system, it may take a long time before much Unix software makes the jump from a character-based interface to a GUI. However, it does have some things going for it. For example, the more powerful workstations that traditionally run Unix have useful advantages over PCs or Macs. On a Macintosh screen, dragging a window is indicated by a dotted outline; in Motif and Open Look, the entire window moves. But the complexity of X Window and the remaining communications bottleneck will continue to keep it substantially slower than its non-Unix competitors. Still, for communicating across networks with a GUI, X Window is far ahead of its competition (see the table).

Coming Attractions?

If GUIs present a far more complex architecture than CLIs, will the next generation bring still more complexity to programmers in the search for easier-to-use software? Probably not. The most innovative systems for desktop computers today are racing toward object-oriented programming.

Apple's MultiFinder, a multitasking operating system for the Macintosh, replaces conventional time-sliced preemptive multitasking with event-oriented, cooperative multitasking. This is a step in the direction of the Smalltalk environment that gave birth to modern GUIs. NeXT's NextStep provides tools designed explicitly to speed up programming. NewWave and applications such as ViewLink and Magellan move much of what was once programming into the hands of users.

Meanwhile, hardware is no longer a critical barrier for better user interfaces. While low-speed TTYs once forced you to deal with CLIs, today fiber optics and inexpensive video technology are making an entirely new set of views possible for your desktop windows. In the Knowledge Navigator, the imaginary future computer that Apple president John Sculley likes to describe to his audiences, an animated talking head answers your questions.

But, in the real world, video images are already part of some GUI systems. The images are what might be called semi-interactive video: You can't change the contents of the video, but you can control how to view the images—in what order and at what speed. The combined GUI/video interface even has a name: the video user interface, or VUI.

One use of semi-interactive video, as part of Japan's TRON project, is in software designed for education and running on a modified PC. In one demonstration, you can watch a short video image of the African grassland and then click with a mouse on various animals or plants within the picture to see close-ups, get information, or run a related video. The video images are stored on a videodisk but appear within windows on the computer screen.

Another use of video in a windowed user interface is in networking, particularly in groupware. Researchers at the Xerox Palo Alto Research Center—home of the first GUIs—have experimented with continuous remote video conferencing between the PARC and a facility near Portland, Oregon. With improving video (and networking) technology, the approach could eventually put the faces of every member of your workgroup on your screen—along with a project, document, or spreadsheet the group is working on.

The VUI is an important step in the evolution of user interfaces for desktop computers. Just as the move from CLIs to GUIs made working with a computer less abstract and more "real," VUIs hold the promise of combining graphical, video, and audio information to bring the real world into the computer. ■

Frank Hayes, a former BYTE news editor, is a writer for UnixWorld and lives in Portland, Oregon. You can contact him on BIX as "frankhayes."

There's gold

Now, Quarterdeck's new

Memory is gold.

And like gold, some of it is hidden away inside your computer. For years, we've been working toward putting it all under your control. And now we can.

Now you can make today's more powerful programs run without giving up network and mouse drivers and TSRs.

Introducing Manifest—the Quarterdeck memory analyzer

Many PC users know there are nuggets of memory sitting unused in most PCs. But those little pieces of memory can add up to 130K!

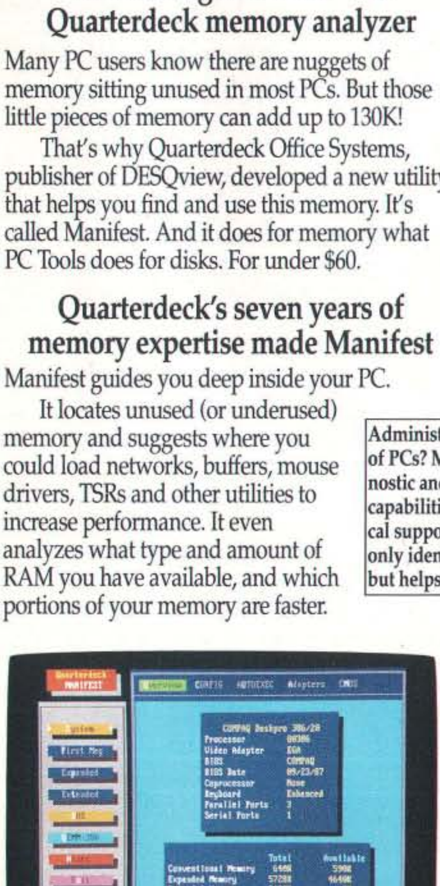
That's why Quarterdeck Office Systems, publisher of DESQview, developed a new utility that helps you find and use this memory. It's called Manifest. And it does for memory what PC Tools does for disks. For under $60.

Quarterdeck's seven years of memory expertise made Manifest

Manifest guides you deep inside your PC.

It locates unused (or underused) memory and suggests where you could load networks, buffers, mouse drivers, TSRs and other utilities to increase performance. It even analyzes what type and amount of RAM you have available, and which portions of your memory are faster.

Administering a number of PCs? Manifest's diagnostic and reporting capabilities reduce technical support time . It not only identifies problems but helps to solve them.



Manifest shows you how your memory works. Here's the first megabyte of RAM, showing unused areas.

Your current memory is full of holes. Our tools can fill blocks of unused addresses between 640K and 1024K to free up memory your programs can use.

Manifest shows you the contents of AUTOEXEC.BAT and CONFIG.SYS files. That can be a big help when diagnosing problems. Manifest tells you all about your hardware, too—from your cpu type to what boards you have installed. Manifest even tests memory speed.

And it runs benchmark tests on expanded memory boards so you can make informed buying decisions.

You won't need a PhD to understand what you're doing. Manifest has an interactive 'manual' that tells you how to use the program and what benefits you'll get.

And unlike a lot of hot new software, Manifest works on virtually any PC: 8088, 8086, 80286 or 80386. It's a productivity breakthrough from the memory experts at Quarterdeck.

INFO WORLD BEST IN ITS CLASS Dec. 18, 1989

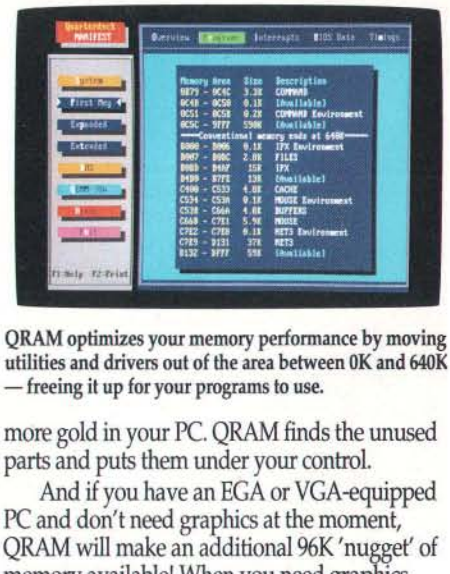
Introducing QRAM—the Quarterdeck memory optimizer

End RAM cram in your 8088, 8086 or 80286 PC once and for all. QRAM (pronounced cram), is a package of utilities that gives you unprecedented control over memory, letting you set up your memory the way it will work best for you.

If you have EMS 4.0 or EEMS boards, QRAM can find unused addresses and 'map' memory to those addresses. Then it looks at your AUTOEXEC.BAT and CONFIG.SYS files and figures out what TSRs, network and mouse drivers and DOS resources can be loaded high and where.

And, like all Quarterdeck memory products, QRAM is compatible with the Microsoft XMS specification used by Windows 286, V. 2.x.

If your PC has 'shadow RAM,' there's even



QRAM optimizes your memory performance by moving utilities and drivers out of the area between 0K and 640K — freeing it up for your programs to use.

more gold in your PC. QRAM finds the unused parts and puts them under your control.

And if you have an EGA or VGA-equipped PC and don't need graphics at the moment, QRAM will make an additional 96K 'nugget' of memory available! When you need graphics again, QRAM will switch you back to graphics mode! Think how helpful that will be for those big dBASE files.

It can't work miracles, but if there's memory available anywhere, QRAM lets you use it to increase your PCs speed and performance.

QRAM is available bundled with Manifest for just a few dollars more than Manifest alone.

Manifest and QRAM—two more examples of Quarterdeck's commitment to mining the most productivity out of the PC and software you own today.

in your PC.

...ools can mine it for you.

Introducing QEMM 50/60 Version5.0

QEMM (Quarterdeck Expanded Memory Manager) 50/60 is the gold standard in memory management for the IBM PS/2™ series 50 and 60. It works with IBM's Memory Expansion Option, Expanded Memory Adapter/A and compatible memory boards.

It supports all three specifications for expanded memory: EMS 4.0, EMS 3.2 and EEMS memory so you can run all expanded memory programs.

And it also works with Microsoft's XMS specification, in case you want to use Windows.

QEMM lets you use memory locations between 640K and 1024K to run TSRs, mouse and network drivers, DOS resources and MCA adaptors. That means you can gain up to 130K of memory space below 640K for your programs.

Best of all, QEMM is designed to be easy to use—even for those new to the PC. Just install it and type 'optimize,' and it looks at your AUTOEXEC.BAT and CONFIG.SYS files and loads whatever it can in high memory. Automatically.

QEMM 50/60 is priced economically. It's the biggest boost you can give your PS/2 for under $100.

System Requirements

Manifest: 8088, 8086, 80286 80386 and i486 PCs & PS/2s

QRAM: 8088, 8086, 80286 PCs. Use of high memory is only available when PC has EMS 4 or EEMS expanded memory or Chips & Technologies shadow RAM.

QEMM 50/60: 80286-based PS/2s and compatibles with IBM PS/2 80286 Memory Expansion Option, IBM PS/2 80286 Expanded Memory Adapter/A or compatible.

QEMM-386: 80386-based PCs and PS/2s and PCs with 80386 add-in boards.

Trademarks: IBM, PS/2: IBM Corporation; PC Tools: Central Point Software; 80386, i486: Intel Corporation, Chips and Technologies: Chips and Technologies

QEMM and DESQview let you multitask and window with the programs you know and use today.

Introducing QEMM 386 Version5.0

QEMM 386 can expand the memory of all 386-based computers, including PCs with 80386 upgrade boards. It makes your memory compatible with EMS 4.0, EMS 3.2 and EEMS memory without having to add special hardware. It's compatible with protected-mode programs (like 1-2-3 Release 3, IBM Interleaf and Paradox 386) using DOS extenders compatible with the Quarterdeck/Pharlap VCPI spec.

QEMM also works with Microsoft's XMS spec to extend memory for Windows users.

QEMM gives you maximum control over your memory between 640K-1024K. It can find unused memory nuggets as small as 4K and use them to free up room for programs to use.

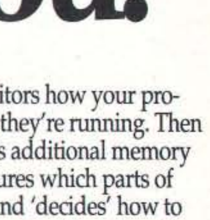
QEMM 386 even monitors how your programs use memory while they're running. Then it shows you where there's additional memory you can use. It even measures which parts of your memory are fastest and 'decides' how to use them for better performance. In action, it's easy and fun—almost like having an *artificial intelligence* program to help tune up your PC.

All these capabilities add up to greater performance at a very low cost. And QEMM lets you go for the gold without having to become an expert on the PC memory puzzle.

Like all Quarterdeck products, it works with your current PC and favorite software.

A few words about DESQview

What's the smartest thing to do with all that additional memory? Run DESQview and multitask your favorite programs in windows. Use a mouse or keyboard and you can run graphic and text-based programs side-by-side. All without having to invest in a bigger hard disk or more memory.



DESQview's recent awards.

From Manifest to QRAM, QEMM and DESQview, Quarterdeck helps you mine the most from the software and PC you have today.

Quarterdeck

150 Pico Boulevard, Santa Monica, CA 90405 (213) 392-9851 Fax: (213) 399-3802

Yes! I need increased productivity on my current PC!

Payment ☐ Visa ☐ MasterCard

Expiration ____/____

Card # ______________

Name ______________

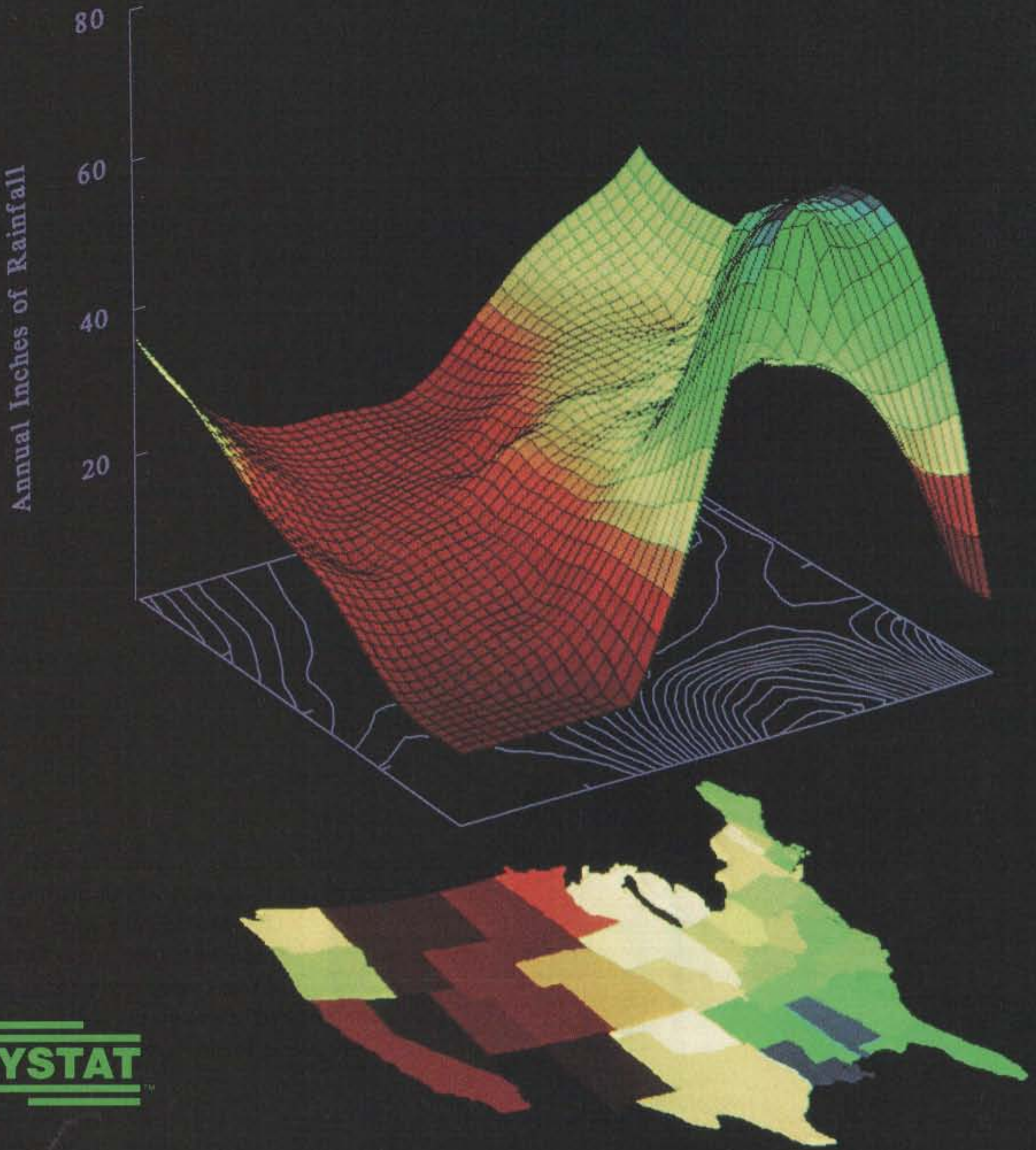
Address ______________

City ______________ State ____ Zip ______

Qty	Product	5-1/4	3-1/2	Each	Totals
	Manifest 1.0			$59.95	
	QRAM and Manifest 1.0			$79.95	
	QEMM 50/60 5.0 (with Manifest*)			$99.95	
	QEMM 386 5.0 (with Manifest*)			$99.95	
	Shipping & Handling $5 in USA/$10 outside USA				
	California Residents add 6.5%				
	Grand Total				

* introductory offer expires 3/31/90

Circle 238 on Reader Service Card



SYSTAT™

The best.

BYTE said it in 1984.
The American Statistician said it in 1985.
InfoWorld said it in 1986, and again in 1988.
PC Magazine said it in 1989.
SYSTAT is the only statistics software to have won both *InfoWorld's* Best in Class award and *PC Magazine's* Editor's Choice award.
SYSTAT is the only statistics package ever to win *InfoWorld's* prestigous Top 100 award.
For five consecutive years, SYSTAT has won every major review in every major publication.

Users agree.
SYSTAT received the top rating in *PC Week's* 1988 user satisfaction poll.
No other statistics company's microcomputer user base rivals the more than 100,000 users of SYSTAT products worldwide.
Find out for yourself why no other company comes close to our record.

MS-DOS,® MACINTOSH,® UNIX,® VMS®
For more information and a free poster of this map, call 708.864.5670 or write SYSTAT, Inc. 1800 Sherman Ave., Evanston, Illinois 60201

Systat. Intelligent software for statistics and graphics.

Circle 275 on Reader Service Card

Behind the Scenes

A good API makes development a piece of cake, and a bad one can drive you bananas

Howard Eglowstein

Providing a user interface that you can learn to use quickly and easily has been a driving force in the computer industry since the Macintosh made "ease of use" a religion in 1984. The major interfaces—DOS and Unix command interpreters, Macintosh Finder, Windows, Presentation Manager, and the X Window System—provide different levels of functionality and comprehensibility.

Deciding which user interface to support in a multiple-machine environment requires more than a simple examination of the different interfaces. It requires an understanding of the programming interface that underlies what you see on your computer screen.

The application programming interface is what gives your program access to the system's resources. A good API will make it easy to concentrate on the task at hand, and a bad one can drive you bananas.

The API lets your program communicate with the operating system, which is responsible for managing all the resources available in the system. At a minimum, this involves managing the keyboard, display, disk drives, and file system. Most personal computers extend operating-system support to include the management of printer ports, serial I/O ports, and memory.

Giving all programs unrestricted access to all system resources would result in chaos. The operating system needs to be in control to sort out conflicting requests for scarce resources. You need a way to tell the operating system what your program needs to do. That's what the API is for.

A Bushel of APIs

At the simplest level, the API is just the definition of the raw operating-system calls. CP/M or DOS programmers who work in assembly language use such calls exclusively.

At the next level, a high-level language like BASIC, C, or Pascal incorporates operating-system calls into its own language primitives and standard libraries, making it easier to use the operating system and providing some level of code portability. The high-level-language approach also cuts down radically on learning time; the language designers have programmed the hardest routines for you.

Perhaps the most interesting API is an event-driven windowing environment. From the outside, a windowing program normally has menu bars and movable windows and uses some sort of pointing device to control a free-roaming cursor. These elements constitute a graphical user interface (GUI). Microsoft Windows and the Mac interface are the most common examples.

A windowing interface combines basic

continued

Listing 1: *Programming DOS in assembly language involves manipulating the registers directly and triggering specific interrupts. This code fragment opens a file.*

```
Fname   db  'FACE.DMG',0
Fhandle dw  ?
;
        mov DX,offset Fname  ; DX register points to the filename
        mov AX,3D00h         ; AH=the 'open' function (3Dh)
                             ; AL=file mode is open for read (00h)
        int 21h              ; Software interrupt 21h is the
                             ; standard MS-DOS file system interrupt.
        jc  Open_error       ; When DOS returns, check the Carry bit to see
                             ; if the operation was successful. If it didn't
                             ; work, jump to our error-handling routine.
        mov Fhandle,AX       ; Since we didn't jump, it must have worked.
                             ; DOS returned the file "handle" in AX.  Save it.
; Go on and do more stuff
```

Listing 2: *This piece of code demonstrates how to open a DOS file using C. The high-level language shields you from the complexities of the assembly API.*

```
#include <stdio.h>             /* Standard DOS information, stored in an include
                                  file. */
char name[] = "FACE.DMG";      /* The file we want opened. */

FILE *fp, *fopen();            /* Open the file, store the 'handle' in fp. */

  if ((fp = fopen(name,"r") != NULL)) {
                               /* If we failed, fp = NULL. Punt. */
       /* Do some stuff with the file. */
       fclose(fp);             /* Close the file. */
       }
  else {
       /* We couldn't open the file. */
       }
```

Listing 3: *Opening the same file from another high-level language, GWBASIC. The same method works under Microsoft QuickBASIC and BASIC 7.0.*

```
10 ON ERROR GOTO 200    : ' If the OPEN doesn't work.
20 ' When the file is opened, it will be accessed as channel 1.
30 ' BASIC "channels" are analogous to MS-DOS "handles."
40 OPEN "FACE.DMG" FOR INPUT AS #1
50 ' If FACE.DMG couldn't be opened, we would have jumped
60 ' to line 200.
70 PRINT "File is opened"
80 CLOSE#1
90 STOP
200 ' Error-handling routine.
```

operating-system calls with special libraries that control the graphics display, pointing device, memory allocation, and (if it is supported) multitasking. A high-level language normally ties it all together. However, unlike conventional text-based applications, the event-driven mode of a windowing interface takes control of all user input.

The GUI checks the keyboard and pointing devices and determines which key press or mouse-click is meant for which program. Along with any timer or other interrupts, these input events are placed in a special *event queue*, which the API controls. Instead of checking the input devices, an application asks the API for any relevant events and processes input by dispatching control to the appropriate *event handler*. Applications that are programmed with an event-driven API have a distinctive look and feel that many people find easier to learn and use. GUIs also provide a more intuitive way of handling a multitasking environment.

Inside the Command Line

DOS and CP/M share a common lineage and thus have similar APIs. In both programming environments, a set of common entry points is set aside for standard operating-system functions. In CP/M (which supports only a 64K-byte program area), the memory at 0005 hexadecimal points to the *jump table*, which contains the address of each of the operating-system functions in a specific order. DOS reserves several of the 808x processor's software-interrupt vectors for accessing the operating system.

With both systems, you access an operating-system function by first placing any necessary addresses or data in the appropriate CPU registers and calling the correct interrupt (DOS) or CALL 0005 (CP/M). The operating system takes control, completes the operation, and returns to your program. Your program finds returned data or status information in CPU registers or designated memory buffers.

Both DOS and CP/M function calls are limited to keyboard input, simple screen output, and disk and file system calls. DOS also provides some control over the division of system memory up to 640K bytes. Running DOS on an IBM-compatible machine lets you access the system BIOS as well, enabling you to control the serial and printer ports, graphics screen, and system clock without doing any low-level programming.

APIs Speak Your Language

If assembly programming isn't to your liking, you can program CP/M and DOS machines in a high-level language. BASIC and C are probably the most commonly used high-level languages. They completely shield you from having to manipulate CPU registers directly.

Listing 1 shows an assembly DOS program opening a disk file. Listing 2 contains the same function, written in C. The C compiler handles all the DOS functions and remaps them into a standard ANSI C format. BASIC performs a similar function, except that the standard BASIC implementation on DOS machines is Microsoft's GWBASIC, which is not an ANSI standard. Listing 3 shows how you open a file using GWBASIC.

In these sample listings, note that the filename is designated using the DOS naming conventions. While high-level languages give you some degree of code portability, the operating system always determines the file-naming convention.

Screen control in DOS is not nearly as flexible as file access. DOS uses the system BIOS to give you simple teletypewriter emulation. By outputting characters to a standard file handle, DOS can pass them through the BIOS to the screen. This handle does not support cursor commands, colors, or any display attributes—just characters. (CP/M implementations at least provided some

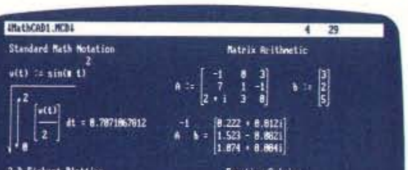
continued

After centuries of practice, mankind perfects engineering calculations: MathCAD.

Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell.

Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.



MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.

MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now—whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

And now we've made the best even better. MathCAD 2.5 is a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, and the ability to import HPGL files from most popular CAD programs, including AutoCAD.® And now you can print on PostScript® compatible printers.

And like before. MathCAD's live document interface™ lets you enter equations anywhere on the screen, add text to support your work, and graph the results. Then print your analysis in presentation-quality documents.

It has over 120 commonly used functions built right in, for handling equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 60,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists, and economists.

But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."

PC MAGAZINE EDITOR'S CHOICE
March 14, 1989 issue.
Best of '88
Best of '87

And for Macintosh® users, we present MathCAD 2.0, rewritten to take full advantage of the Macintosh interface. Entering operators and Greek letters into equations is pure simplicity!

Look for MathCAD 2.5 at your local software dealer, or give us a call. For more information, a free demo disk, or upgrade information, dial 1-800-MATHCAD (in MA, 617-577-1017).

Available for IBM® compatibles and Macintosh computers.

TM and ® signify manufacturer's trademark or manufacturer's registered trademark respectively.

MathCAD®

MathSoft, Inc. One Kendall Square, Cambridge, MA 02139

U.K.: Adept Scientific 0462-480055; **France:** ISE CEGOS 1-46092768; **Germany:** Softline 07802-4036; **Japan:** CRC 03-665-9768.

PE #3

Circle 177 on Reader Service Card

form of terminal emulation, normally with VT52 or similar escape sequences.) However, an IBM-compatible machine gives you control over display attributes, such as cursor location and text colors, through calls to the system BIOS.

In assembly language, you set screen attributes using the INT 10h BIOS interrupt and access the display-file handle through the INT 21h DOS interrupt. GW-BASIC provides its own interface to the BIOS. Sadly, standard C libraries provide only the teletypewriter emulation of DOS—C does not support BIOS calls. To correct that omission, most compilers can be fitted with function libraries that give you full control over the screen. In some cases, these libraries come with the compiler. They are also available from numerous third-party developers.

DOS and Don'ts

DOS is essentially a collection of device-control functions waiting to be called by your application program. Writing for DOS is simply a matter of working in the standard definition of a language, making the appropriate function calls as needed. This limits your program to the functions that DOS defines. (It also restricts your programs to a maximum of 640K bytes of memory.)

Thus, DOS programs tend to be very keyboard-oriented and often have a sparse look about them. Perhaps the most common complaint from DOS users is the lack of a standard user interface. Because DOS handles only basic screen output or keyboard entry, your program is free to use any keystrokes you wish. You can also make the screen look any way you please. However, if you choose to use the DOS API, you should strive to be consistent.

The Nonstandard Standard

Unix has been around much longer than DOS, but it wasn't a practical operating system for desktop equipment until the arrival of fast processors, cheap memory, and high-capacity hard disk drives. Unix is semiportable, and it has been adapted to many different processors and architectures. In the world of Unix, however, there's no such thing as standard hardware, never mind a standard machine-instruction set. If you're going to work with Unix, you have to stay with C or some other high-level language.

C programs written for Unix, like those written for DOS, are based on the standard ANSI C definition. Each Unix manufacturer provides a specific flavor of C compiler designed to generate code compatible with its hardware. All you have to do is write standard C, compile it on your machine, and you're set. File I/O works through `fopen( )`—even the keyboard, since C maps all keyboard input to the `stdin` file pointer.

In theory, any program you write for a DOS machine should compile directly under Unix. There are exceptions, so you can't expect to have portable code if you use direct memory pointers or make assumptions about internal data formats.

The Unix Difference

Unix systems usually have more memory than DOS machines—*lots* more. Unix system libraries have built-in support for terminal control and true multitasking.

In Unix, there's no such thing as standard hardware, never mind a standard machine-instruction set.

Preemptive multitasking can make programming a complex system much easier on a Unix machine than it is on a DOS machine. For example, say you're writing the ultimate word processing package and you want it to run under both DOS and Unix. One feature you want to add is background printing, where the software can print one file while editing another.

DOS provides two ways to accomplish this, neither of them terribly elegant. Because a word processor spends most of its time waiting for keystrokes, you can perform limited multitasking within the code by writing a keyboard-sampling routine that prints out a few characters, then samples the keyboard, and then prints a few more characters. Since your program polls the keyboard at regular intervals, this approach works well for a word processor. It is not appropriate for most programs, however.

Another facility available under DOS is the background "multiplex" interrupt, which will perform simple background tasks as a part of DOS's overhead. A standard DOS utility, PRINT, uses this interrupt to handle file printing in the background. A number of DOS word processing packages send output to a temporary file and then have DOS use PRINT to output the file. Elegant? No, but it is functional.

On a true multitasking operating system such as Unix, you can spawn a separate task to handle printing. In fact, this task could be a separate copy of the same word processor. The spawned task handles the printing as needed and then destroys itself. The operating system handles task switching and resource conflicts automatically, making the code much simpler.

Terminal Affairs

Screen I/O under Unix isn't much better than it is under DOS. When Unix was developed, bit-mapped graphics screens were an oddity. Until the advent of the microcomputer, all output screens were part of data terminals, some of which featured better functionality than others.

Unix handles a terminal by treating it like a file and using standard file I/O commands to spit characters back and forth. Simply sending ASCII characters wouldn't give you any cursor control, and it's impractical to write support for every possible terminal type into your program. (This is not a problem under DOS, however, because all PCs look alike to DOS.)

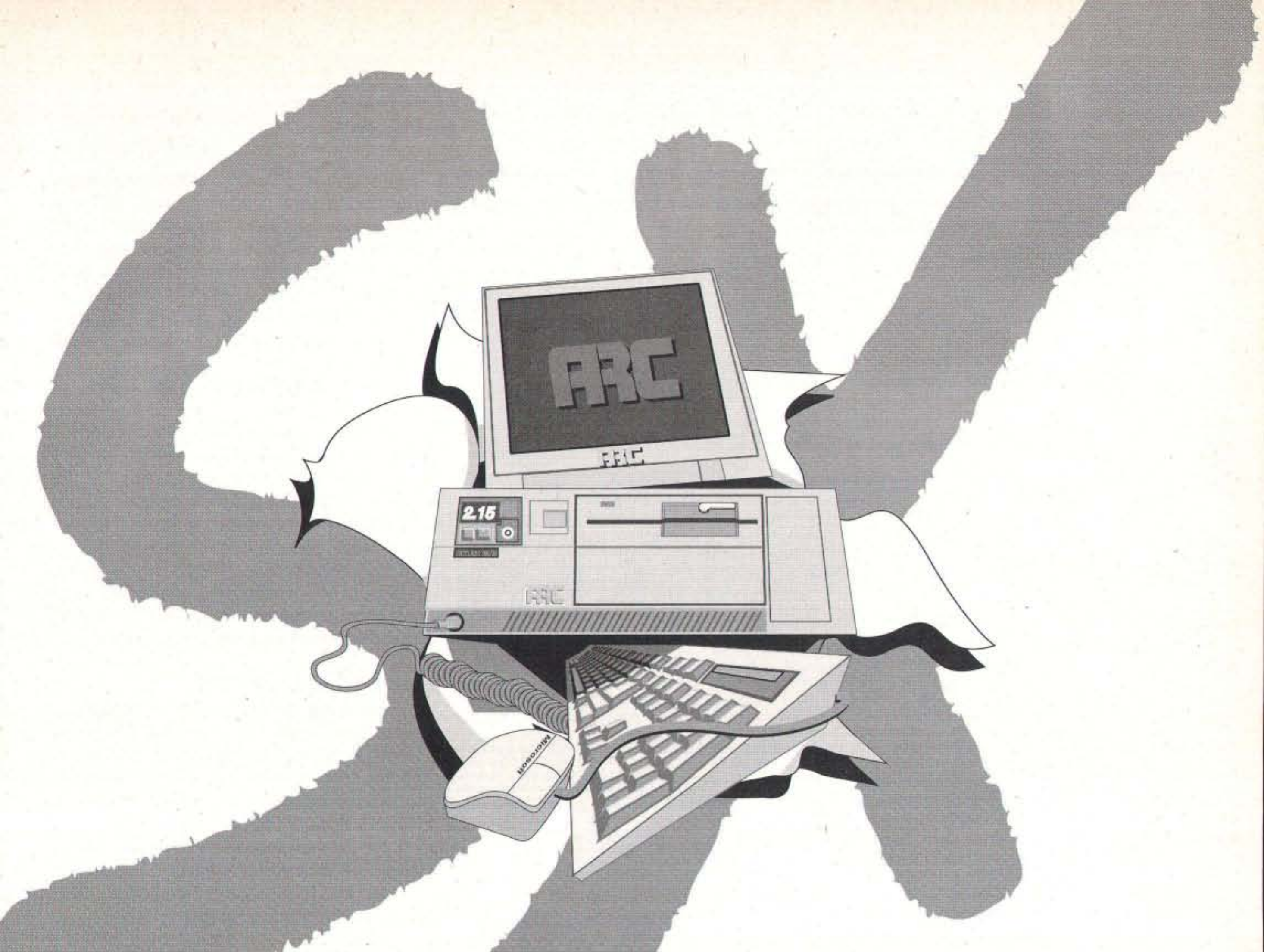
To get around this problem, Unix systems provide you with a standard terminal-interface package. A terminal is assumed to support a standard set of functions, driven by escape sequences. A table of all possible terminals is stored in the Termcap file, and the system variable TERM will tell your program which kind of terminal it's on. It's not nearly as convenient as the single DOS machine type, but it's a good compromise and is one step toward a device-independent interface.

A Sashay Through the Windows

Imagine adding one layer of graphics support between you and the operating system. Further, give this layer complete control over the system memory, keyboard, and file system. Then, have the graphics support offer a wide variety of window types and support any type of screen (within reason). What you wind up with is an API that supports a GUI.

Apple calls its GUI API the Toolbox and puts it into the system ROM of every Macintosh it makes. DOS users can buy something similar (in the guise of Windows/286 or Windows/386). Those running OS/2 have access to similar technology with Presentation Manager. In the following discussion, I use Mac termi-

continued


ARC
2.15
Microsoft

Listing 4: *A sample Macintosh event loop. Most of the code has been removed to show the file structure better.*

```
{This source is for MPW Pascal}
Program  Excellent;
{Program name:  Excellent.P}
{Function:  This is the main module for this program.}
{History: 1/2/90. Original by Prototyper.}

   repeat                           {Start of main event loop}
     if (theInput <> nil) then      {See if a TE is active}
        TEIdle(theInput);           {Blink the cursor if everything is OK}
     SystemTask;                    {For support of desk accessories}

     if GetNextEvent(everyEvent, myEvent) then
                                    {If event then...}
        begin                       {Start handling the event}
           code := FindWindow(myEvent.where, whichWindow);
                                    {Get which window the event happened in}

           case myEvent.what of     {Decide type of event}
              MouseDown :           {Mouse button pressed}
                 begin              {Handle the pressed button}
                    if (code = inMenuBar) then
                                    {See if a menu selection}
                        begin       {Get the menu selection and handle it}
                           {Do the menu-handling stuff here}
                        end;        {End of inMenuBar}

                    if (code = InDrag) then
                                    {See if in a window drag area}
                        begin
                           {Do the window dragging stuff here}
                        end;        {End of InDrag}

                    if ((code = inGrow) and (whichWindow <> nil)) then
                                    {In a grow area of the window}
                        begin
                           {Window growing stuff}
                        end;        {End of doing the growing}

                    SystemClick(myEvent, whichWindow)
                                    {Let other programs jump in}
                 end;               {End of MouseDown}

              KeyDown,AutoKey:      {Handle key inputs}
                 begin              {Get the key and handle it}
                    {Get the key, and dispatch to any routines}
                 end;               {End for KeyDown,AutoKey}

              UpDateEvt :           {Update event for a window}
                 begin              {Handle the update}
                    whichWindow := WindowPtr(myEvent.message);
                                    {Get the window that the update is for}
                    BeginUpdate(whichWindow);
                                    {Set the clipping to the update area}
                    EndUpdate(whichWindow);
                                    {Return to normal clipping area}
                 end;               {End of UpDateEvt}
           end;                     {End of case}
     end;                           {end of GetNextEvent}
   until doneFlag;                  {End of the event loop}
end.                                {End of the program}
```

nology. Bear in mind, however, that Windows, PM, and the Macintosh are similar and work in much the same way.

In an event-driven environment, the operating system automatically samples the keyboard, mouse, serial ports, and other sources of input. The windowing software directs input events into the proper window's queue. The software then calls the program that controls the window.

When notified of an event, your program looks at the event type and dispatches a routine to handle it. Normally, this event handling takes the form of a case statement in C or Pascal.

Your program would normally provide routines to handle keystrokes, mouse movements, serial I/O (if you're using the serial ports), button clicks, and disk insertions. In addition, the windowing software informs your program when its window is covered up by other windows, when it's uncovered, and when it should be closed.

Listing 4 is a Pascal program (Excellent.P) for the Macintosh that displays a window and waits until you select Quit from the System menu. Most of the meat has been removed to make the structure visible.

`GetNextEvent` returns the next event in the queue. The `case` statement isolates `MouseDown` and `KeyDown` events, calls the necessary routines, and then loops until `doneFlag` is set. In a complete program, `doneFlag` is set by clicking the close box, selecting `Quit` from the System menu, or some other action. `SystemClick` passes a `MouseDown` event off to activate desk accessories.

Microsoft Windows uses a similar scheme. Listing 5 is an excerpt from SHOBITS, a program in C that displays arbitrary graphics on the screen and wraps text around them. `WinMain` is the main procedure that displays the graphics window and polls for messages from the event queue. Note the structural similarity between the Windows program and the Macintosh program. In this example, `GetMessage` serves the same purpose as the Macintosh's `GetNextEvent`.

Share and Share Alike

Windowing systems are often multitasking, so it's possible that other programs will be vying for the same resources. Thus, the windowing system normally manages memory, as well as screen I/O, which requires special calls to send text to the active window. Keystrokes come in through the event queue. File I/O, on the other hand, is usually handled directly by the operating system.

Multitasking is handled in various ways. Nonpreemptive systems such as the Macintosh use cooperative multitasking, which takes advantage of the fact that programs have to query the system for events. By asking for an event, the program indicates to the event handler that it is waiting for something to do. Another program can then get control of the processor for a while and return control when it is waiting for an event.

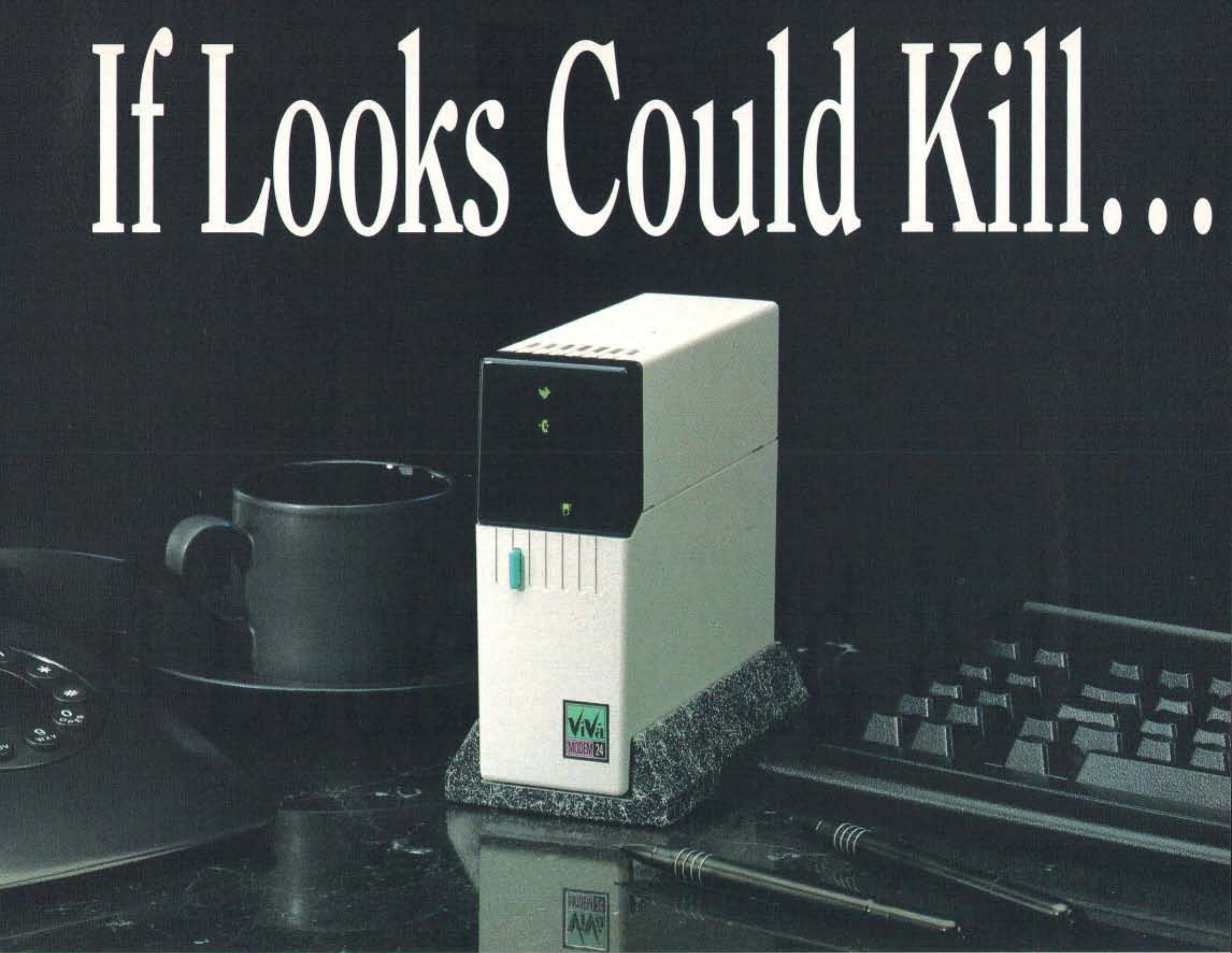
If all the programs on such a system are well behaved, then everyone gets a turn. Of course, there are always a few programs that don't play fair and never relinquish control. On the Macintosh or under Windows, there simply is no way for an application to regain control from these ill-behaved ones.

On the other hand, OS/2 is truly a preemptive operating system, and PM can simply take control whenever it wants. Whether you have a preemptive or nonpreemptive environment, it's best to make sure your applications can coexist with other programs in a multitasking system.

A Standard Standard

Windowing interfaces depend on high-resolution graphics displays. In this

continued



The ViVa24 Modem knocks 'em dead with style and convenience.

Finally! An affordable, state-of-the art modem designed to maximize any work station or desktop and take up minimal space. The new 2400 baud modem from Computer Peripherals, Inc. is a 100% Hayes compatable external modem which boasts more high-tech features than its competition at an unbelievable price tag.

The compact, distinctively sleek tower design simplifies placement, and it's easily accessible, front panel power switch eliminates fumbling around the back of the unit. The handsome weighted base holds the ViVa24 firmly in place, and sharp LED indicator lights are aligned for comfortable viewing, utilizing international graphic icons that make the ViVa24 simple to understand.

The small tower design creates a natural flow of air over the surface of the board, allowing the ViVa24 to run cooler and affording you 24-hour, worry-free operation. The Viva24 modem provides the user compatability with IBM PC, XT, AT, IBM PS/2, Apple Macintosh computers and any computer that supports RS-232C.

The ViVa24 modem represents innovation from its footprint up with features such as: use of the Hayes "AT" command set, asynchronous data format, auto-dialing, auto answer, adaptive equalization, non-volatile memory, automatic tone and pulse dialing, remote access while your computer is unattended, self-test and built-in diagnostics. Best, of all, the ViVa24 is fully backed with a five-year limited warranty.

Before investing in an ordinary modem, be sure to investigate the ViVa24.

Call your nearest dealer or call us for details.

Circle 66 on Reader Service Card (DEALERS: 67)

HIGH FIDELITY™

By Computer Peripherals, Inc.
667 Rancho Conejo Blvd. • Newbury Park, CA 91320
TEL: (805) 499-5751 • Toll Free (800) 854-7600 ext. 22
FAX (805) 498-8848 • TLX: 59299 CPI

Trademarks: IBM, International Business Machines, Corp.; Hayes Microcomputer Products; Apple Macintosh; High Fidelity, Computer Peripherals, Inc.

Listing 5: *A main procedure and event loop from Microsoft Windows.*

```
Listing 5

/* The Source file:  shobits.c  */
#include "windows.h"
#include "shobits.h"               /* There's no bits like SHOBITS */

int PASCAL WinMain( hInstance, hPrevInstance, lpszCmdLine, cmdShow )
{
    msg.wParam = 0;

    if ( hPrevInstance ) {
        /* Copy data from previous instance */
        }
    else {
        /* Call initialization procedure - this is the first instance. */
        }

    if (hWnd = CreateWindow((LPSTR)szAppName,
                            (LPSTR)szMessage,
                             WS_TILEDWINDOW,
                             0,     /*  x - ignored for tiled windows */
                             0,     /*  y - ignored for tiled windows */
                             0,     /* cx - ignored for tiled windows */
                             0,     /* cy - ignored for tiled windows */
                             (HWND)NULL,          /* no parent */
                             (HMENU)NULL,         /* use class menu */
                             (HANDLE)hInstance, /* handle to window instance */
                             (LPSTR)NULL ) ) {  /* no parameters to pass on */

        hInst = hInstance;          /* Save instance handle for DialogBox. */

        while ( GetMessage( (LPMSG)&msg, NULL, 0, 0) ) {
                                    /* Polling messages from event queue. */
           TranslateMessage( (LPMSG)&msg );
           DispatchMessage( (LPMSG)&msg );
           }
    }
    return (int)msg.wParam;
}

}
/* Procedures that make up the window class. */
long FAR PASCAL ShoBitsWndProc( hWnd, message, wParam, lParam )
   switch (message)
      {
      case WM_SYSCOMMAND:
          switch (wParam)
              {
              case IDSABOUT:
                  DialogBox( hInst, MAKEINTRESOURCE(ABOUTBOX), hWnd,lpprocAbout );
                  break;
              default:
                  return DefWindowProc( hWnd, message, wParam, lParam );
              }
          break;
      case WM_DESTROY:              /* Quit was selected from the File menu */
          PostQuitMessage( 0 );
          break;
      case WM_MOUSEMOVE:            /* Any time the mouse moves */
          if (bMouseDown) {
              /* Erase old line and draw a new one */
              }
          break;
      case WM_LBUTTONDOWN:          /* If either mouse button is pressed */
      case WM_RBUTTONDOWN:
          if (!bMouseDown) {
              /* snag a starting X and Y coord */
              }
          break;
      case WM_LBUTTONUP:
      case WM_RBUTTONUP:
          if (bMouseDown) {
              /* The button was down and has just been released */
              }
          break;
      case WM_PAINT:          /* Windows has just asked us to repaint the screen */
          BeginPaint( hWnd, (LPPAINTSTRUCT)&ps );
          if ( PlsAddTxt ) {        /* Wrap two columns of text */
              Column1 ( hWnd, GetDC( hWnd ) );
              Column2 ( hWnd, GetDC( hWnd ) );
              }
           PlsAddTxt = FALSE;
           ReadClipboard ( hWnd, GetDC( hWnd ) );
           XorBox ( hWnd, startx, starty, endx, endy );
           EndPaint( hWnd, (LPPAINTSTRUCT)&ps );
           break;
      default:                      /* Any message we don't have a handler for */
           return DefWindowProc( hWnd, message, wParam, lParam );
           break;
    }
    return(0L);
}
```

UnNetwork.

All the power of The Software Link's PC-MOS operating system. All the benefits of both individual and networked PCs.

All in one high-performance, low-cost, multi-tasking system. With no terminals and no additional PCs — unless you want to optionally use your old XTs or ATs.

The UnTerminal™ UnNetwork.™

It's the ideal multiuser system for personal computer users.

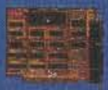
UnTerminal monitor-keyboard workstations cost less than terminals. Less than text-only "intelligent I/O" solutions. Less than fiber-optic graphics solutions.

An independently operating UnTerminal workstation outperforms them all. With faster screen refresh — text *and graphics.* Instant switching between single and multiuser screens. Running popular DOS applications. And making every user feel like the only user.

Inexpensive monitor-keyboard workstations replace costly terminals and PCs on the UnTerminal™ UnNetwork.™ Run multiuser and popular PC programs at the same time— with no terminals or PCs—or use any XTs and ATs you happen to have.

The UnTerminal Video Network Adapter™ supports up to 4 Hercules-compatible workstations.

The UnTerminal Video Network Graphics Adapter™ supports up to two color graphics workstations—resolution up to 800 x 600.



The UnTerminal Connect Card makes an XT or AT into a multitasking, multiuser workstation.

Just add PC-MOS, monitors & keyboards.

The Software Link's PC-MOS multiplies the power of your PC. Why pay extra just to get the boxes? You can run up to eight color or 16 monochrome UnTerminal workstations per system — and save thousands.

Distributed by
The Software Link, Inc.

For more information, call: The Software Link, Inc. at (800) 451-LINK or (404) 448-5465.

Hercules compatible graphics using the UnTerminal (VNA).

Color graphics embedded in database using the UnTerminal (VGNA).

800 x 600 VGA graphics using the UnTerminal (VGNA).

Now XTs and ATs can be UnTerminals, too. Hotkey between local and host applications using the UnTerminal (VCCA).

THE SOFTWARE LINK

The PC-MOS UnTerminal

PC-MOS MULTIUSER SYSTEMS WITHOUT TERMINALS

The Software Link, Inc., 3577 Parkway Lane, Norcross, GA 30092.
Phone: (800) 451-LINK or (404) 448-5465, FAX: (404) 263-6474, Telex: 4996147 SWLINK.

PC-MOS is a trademark of The Software Link, Inc. UnTerminal, UnNetwork, Video Network Adapter, Video Connect Card Adapter and Video Graphics Network Adapter are trademarks of Advance Micro Research, Inc.

Circle 263 on Reader Service Card (DEALERS: 264)

regard, the Mac Toolbox enjoys the advantage of always running on a Macintosh. There are no problems with nonstandard displays. The Toolbox can run any program on any type of display that conforms to Apple's standard. In fact, you can have your program ask the Toolbox about the color and resolution of the display and use this information in your program. Device independence on the Macintosh is excellent.

The PC, however, has few standards, and life with Windows becomes interesting because of it. Microsoft has built in support for the usual screen displays: CGA, EGA, and VGA. Because of the popularity of the monochrome Hercules graphics board, recent versions of Windows now support that card as well. But that's about it. If you want to use one of the new full-page displays with Windows, you will have to make sure that the manufacturer supplies a Windows driver. PM is limited to standard Windows devices.

Cooking Up an Application

APIs are not all sweetness and light. Those who work with Windows or the Macintosh probably consider the DOS API half-baked. Conversely, the eyes of those involved with DOS tend to glaze over when they first investigate Windows. Happily, the recipe for picking the right API is an easy one.

If you work on the Macintosh, you have no choice. The standard Mac operating system is programmed solely through the Toolbox and event-loop programming. A/UX, the Unix port for the Mac II family, combines the multitasking of Unix with the best of the Toolbox functions.

The X Window System is a standard that is beginning to show up on Unix workstations. However, the GUIs built on top of it are not yet generally available on desktop machines and are incompatible with one another. Until the X Window System–based GUIs make greater inroads into the desktop arena, Unix hackers will have to be content with their true multitasking and Termcap screen control.

If you work on an IBM-compatible machine, you have a few options. Programming conventional DOS applications is easy, and the new crop of DOS extenders allows access to memory beyond the standard 640K bytes. You can choose between two GUI environments: Windows running under DOS, and PM running under OS/2. All three of these APIs have appeal.

If your applications rely heavily on multitasking, OS/2 is probably the correct choice. However, it may be a long time before OS/2 becomes the standard operating system for IBM compatibles, if it ever does.

If you need to be able to port your application to other machines, straight C under DOS or Unix would be a good choice. If ease of use is a primary concern, then Windows may well be your best choice.

Examining user interfaces is only part of the picture in determining which system to support. Understanding the strengths and weaknesses of each API and matching the right API to the job at hand will make your efforts much more fruitful. ■

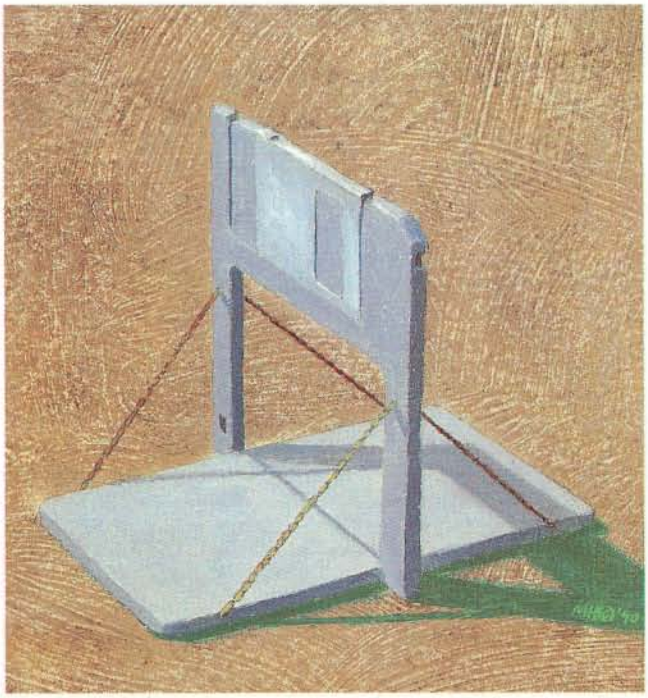
Howard Eglowstein is a testing editor for the BYTE Lab. He can be reached on BIX as "heglowstein."

Bridging Troubled Waters

Cross-platform tools can save time and money —and perhaps your sanity

Jon Udell

As desktop computing "standards" proliferate like wildfire, both users and software developers face a similar question: Which machine, and which operating system, should they support? DOS continues to dominate the installed base of microcomputers and thus has the greatest software support, but the Mac has many attractive features, and Unix and OS/2 are coming on strong.



All this results in four operating systems (lumping together the many Unix variations); five major graphical user interfaces—Microsoft Windows, OS/2's Presentation Manager (PM), the Mac, and the X Window System-based Motif and Open Look; many more minor GUIs; and an uncounted number of different machine architectures.

The choice comes down to limiting your prospects by supporting one machine or facing the daunting prospect of supporting multiple, complex computing environments and application programming interfaces (APIs).

New tools, however, can provide a third alternative. What if you could write an application once to a universal API and then move it to a variety of popular systems? This would make it easy to support multiple standards and to use the same software on different machines.

I will discuss five toolkits that allow this kind of portability. XVT and Smalltalk/V (both of which are general-purpose toolkits), HOOPS and Design/OA (two graphics libraries), and FoxBase (a DBMS) each provide a common API across multiple platforms. These toolkits—and others like them—can make it easier for users and programmers to support multiple environments.

Solving a Sticky Problem

XVT (for Extensible Virtual Toolkit) from the Advanced Programming Institute is a set of libraries, one for each graphical environment that it supports. Each library maps a set of common XVT function calls to equivalent system-specific calls. For example, XVT's `new_window` turns into `NewWindow` on the Mac and `CreateWindow` under Microsoft Windows.

But XVT is more than a Rosetta stone. Although Windows, PM, and the X Window System (referred to as X Window for the remainder of this article) owe much to the event-driven style of programming that the Mac has popularized, they differ from the Mac and from one another in ways that go beyond a one-for-one translation of function names.

For example, each GUI system defines a different set of events. There are 11 Mac events, 24 X Window events, and more than 100 Windows messages. XVT

continued

makes do with 15 events. How does it handle all the complexity of Windows with so few events? It doesn't.

For the sake of portability, XVT sacrifices some of the uniqueness of each of the environments it supports. So you lose, for example, Dynamic Data Exchange, which carries conversations between concurrently executing Windows or PM programs and supports interapplication *hot links*. Since there isn't a DDE analog on the Mac yet, XVT pretends that Windows and PM don't have DDE, either.

Common Cause

Still, XVT handles the basics nicely. Recently, I wrote an XVT program to try out the capabilities of a mixed Mac and PC network. My goal was to build a simple multiuser database that would present an identical user interface to PC and Mac users. Although I'm a relative beginner when it comes to GUI programming, my progress was swift.

Building on the examples provided ("clone first, ask questions later" is my motto), I put together a simple program that displays three flat-file databases, each in its own scrollable window, and provides menu options to add, search for, and delete records. The C source code for the Mac and PC versions was identical. Well, almost identical.

My application needed some network functions (e.g., open a file in share mode, lock a record, unlock a record) that XVT doesn't provide. So I defined my own common interface to these functions and supplied separate Mac- and PC-specific implementations.

The other nonportable part of the project was the resource scripts required to build the program's menus and dialogues. XVT does provide a tool that translates Macintosh RMaker scripts to Windows resource-compiler scripts. And because I used Prototyper 2.0 from SmethersBarnes to build the menus and dialogues interactively, tuning the sizes and locations of dialogue components was easy. Nonetheless, XVT's success in creating a uniform GUI programming environment makes you wish for a uniform resource-tinkering environment, as well.

One result of XVT's least-common-denominator approach is that an XVT program is somewhat simpler than its native counterparts. For example, under Windows, you have to register each window as a member of a window class and provide a filter that can trap messages sent to that window before they go to the default message handler. In XVT, as on the Macintosh, you can simply create a window.

The Mac in native mode, however, requires more work to make that window behave properly. Say you indicate, by clicking the mouse, your intention to drag a window across the Desktop. The programmer must ask the Toolbox which window received the mouse-click, determine that the click happened in the window's `inDrag` region, and then explicitly call the Toolbox's `DragWindow` function. XVT, like Windows, handles these details automatically.

XVT's success in creating a uniform GUI programming environment makes you wish for a uniform resource-tinkering environment, as well.

Vive la Différence!

Although XVT smooths out the differences among platforms, it doesn't stamp them out completely. Nor should it. Although the two halves of my database application looked alike, each retained the flavor of its native environment. Under Windows, I could minimize the application's window to clear space for other applications; on the Mac, the application joined MultiFinder's round-robin.

XVT's method for handling font selection illustrates nicely the interplay between portability and diversity. For each environment, XVT defines a font-selection menu. Because the families, styles, and sizes of fonts are necessarily system-specific, a portable program can't refer directly to the contents of that menu.

XVT's solution is fascinating. It defines a new event, called the `font` event, which the system sends to an XVT program when you request a font change. The program can then query the system, find out that you asked for, say, font family 15, size 3, and then ask the system to make those the effective settings. It never uses a nonportable name such as "12-point Times Roman."

This scheme has a surprising consequence, though. An application cannot itself decide to use 12-point Times Roman type. It can only enable you to do so. Because XVT uses drab system fonts by default, this limitation is frustrating. An application can only ask for "big," "normal," and "small" sizes of the default font. I hope future versions of XVT will let an application ask for a style, too.

It's important to understand what XVT isn't, as well as what it is. It isn't intended for shrink-wrapped commercial products like Aldus PageMaker or Microsoft Excel. The authors of these programs use all the environment-specific knowledge they possess to squeeze the last drop of performance out of them. However, if you don't have the time or inclination to master multiple GUIs but still need useful software that is available across the diverse mixture of graphical computers that populate offices today, XVT makes portability practical.

Catching Up with Smalltalk

When BYTE dedicated an entire issue to Smalltalk in August 1981, it was the first glimpse many readers had of two intertwining themes—the GUI and object-oriented programming (OOP). At the time, however, Smalltalk was little more than an academic curiosity. The Apple II and CP/M systems of the day couldn't support Smalltalk, and most people could only dream about the Xerox workstations shown in the articles.

Today, the descendants of those exotic workstations roll off assembly lines. The Macintosh, Windows, and PM operating environments embody the GUI and OOP ideas that Smalltalk inspired. Yet Smalltalk itself, designed specifically to help explore and construct complex graphical applications, remains exotic.

Smalltalk may yet have its day. Two main dialects of the language exist, and each spans multiple platforms. ParcPlace Systems' Smalltalk-80, a direct descendant of the original Xerox PARC system, runs on Sun, Apollo, and HP 9000 workstations, as well as Macs and 386 PCs. Digitalk's Smalltalk/V, the one I've worked with, has 286 (non-Microsoft Windows), Macintosh, and PM incarnations.

The two dialects differ considerably. Their underlying class libraries aren't compatible. And in the same way that Smalltalk-80 makes each of its hosts look and feel like a Xerox workstation, Digitalk's latest offerings, Smalltalk/V Mac and Smalltalk/V PM, wear the look

continued

Discover Parallel Processing!

Monoputer/2™

The World's Most Popular Transputer Development System

Since 1986, the MicroWay **Monoputer** has become the favorite transputer development system, with thousands in use worldwide. Monoputer/2 extends the original design from 2 to 16 megabytes and adds an enhanced DMA powered interface. The board can be used to develop code for transputer networks or can be linked with other Monoputers or Quadputers to build a transputer network. It can be powered by a 20 or 25 MHz T800 and is priced from $1295.

Quadputer™

Mainframe Power For Your PC

MicroWay's **Quadputer** is the most versatile multiple transputer board on the market today. Each processor can have 1, 4 or 8 megabytes of local memory. In addition, two or more Quadputers can be linked to build large systems. One MicroWay customer reduced an 8 hour mainframe analysis to 15 minutes with five Quadputers, giving him realtime control of his business. Quadputer is priced from $1995.

Parallel Languages

Fortran and C Make Porting a Snap!

Microway stocks parallel languages from 3L, Logical Systems and Inmos. These include one Fortran, two Cs, Occam, Pascal, and Ada. We also stock NAG libraries for the T800 and ParaSoft's debugger, profiler, and Express Operating Environment. A single T800 node costs $2,000, yet has the power of a $10,000 386/1167 system. Isn't it time you considered porting your Fortran or C application to the transputer? It's easier than you think!

For further information, please call MicroWay's Technical Support staff at (508) 746-7341.

COSMOS™/M

Finite Element Analysis Running on the Quadputer

One of the most fruitful areas for parallel processing is finite element analysis. Problems which can be broken into small pieces run naturally on systems built up of many processors. **COSMOS/M** running on a Quadputer took just 300 seconds to solve a problem which ran in 12,000 seconds on an AT. Even very large mainframe problems run fast on the Quadputer: a system with 12,000 degrees of freedom took just 806 seconds while another that had 23,000 DOF ran in just 40 minutes. Contact MicroWay for information on COSMOS/M.

Attend a MicroWay-sponsored Parallel Processing Seminar: Munich, FRG May 29-30, 1990

MicroWay

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, U.K., 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

Listing 1: *Programming the Smalltalk way involves creating methods that interact with objects via messages. Smalltalk is a natural for developing GUI-based applications.*

```
|window file list word|              "declare local variables"
window := TextEditor                 "create window"
  windowLabeled: 'Test'
  frame: (0 @ 0 extent: 400 @ 100).
file := File pathName: 'test.txt'.  "open file"
list := Bag new.                     "create an empty collection"
[(word := file nextWord:) isNil]     "read words into collection"
  whileFalse: [list add: word].
list asSet asSortedCollection        "eliminate duplicates and sort"
  do:
    [:w|                             "get each item"
      window
         nextPutAll: w;              "send it to the window"
         cr].                        "followed by carriage return"
```

that's locally appropriate. Either way, you get a machine-independent programming toolkit.

Digitalk's host-sensitive approach, coupled with the improved performance and packageability that the new Smalltalk/V PM supports, has recently ignited something of a Smalltalk revival. Leading the charge, Microsoft's Bill Gates delivered the ringing endorsement that Smalltalk/V PM is "the right way to develop PM applications."

An Object Lesson

Smalltalk's all-encompassing object orientation takes some getting used to. Listing 1 shows a snippet of Smalltalk/V code—a *method*—to read a text file and write a sorted list of the different words that it contains to a scrollable window.

The short code does quite a bit of work. The `TextEditor` and `File` objects respond to the "messages" they receive by asking the host to open a document window and a file, respectively, and by returning Smalltalk objects (assigned to `file` and `window`) that can be used to manipulate them. The `Bag` object answers the message `new` with an object that can hold a bunch of objects of any kind.

Next, the method sends `nextWord` to `file`, assigns the result to `word`, and sends `isNil` to `word`. To the resulting object—a Boolean, since the response to `isNil` will be true or false—the method sends `whileFalse` along with a block of code to be evaluated each time a non-nil `word` appears. That block, in turn, tells `list` to add `word` to itself.

Finally, the method sends `list` the messages `asSet` (return yourself without duplicates), `asSortedCollection` (return yourself sorted), and `do`. The `do` message iterates over `list`, picks up each word, and asks `window` to display it.

I'll agree that the syntax looks strange. But is it really any stranger than the equivalent Microsoft C or Think C programs, with their event loops and baroque APIs? And the Smalltalk code is *much* smaller than its C counterparts would be.

The Smalltalk Way

Smalltalk encourages an exploratory, cannibalistic style of programming. For example, when I moved the word-cataloging code from the Mac to PM, I decided to add a fancy way to choose the input file. The Smalltalk/V PM environment has a nifty "Browse Disk" menu option. It activates a multipane window that works like PM's own File Manager. The browser is an instance of a Smalltalk class called DiskBrowser. So I created another instance,

```
DB := DiskBrowser new open.
```

I selected a directory and a file and then asked the Smalltalk object inspector to unpack `DB`. It showed me that two instance variables, `selectedDirectory` and `selectedFile`, held the information I needed. Did the DiskBrowser class already define methods to return those items? No, the Class Hierarchy Browser reported, so I used its method editor to create them. Practically for free, my program got a big chunk of the system's user interface. That's the kind of reusability that makes some people religious about Smalltalk.

With all this to offer (and portability, too), why does the language's profile remain low? There are four reasons. Historically, Smalltalk applications didn't adapt to native windowing systems, ran more slowly than did conventional programs, were far more difficult to package and distribute, and required mastering an abstruse class hierarchy.

Smalltalk/V Mac silenced the first objection; Smalltalk/V PM attacks the remaining ones. It replaces the traditional interpreted "image" with a true OS/2 executable file, into which methods incrementally compile. That executable file, along with dynamic-link libraries containing necessary run-time support, constitutes a stand-alone PM program—and a pretty fast one at that.

Finally, the traditional scheme for organizing an application's windows, the "model-Pane-Dispatcher" class triad, has evolved into a more natural system based on a new class, ApplicationWindow. The new PM class hierarchy compromises Smalltalk/V's portability to a degree. If you rely on the new classes (although you don't have to), your code won't be guaranteed total transportability to other Smalltalk/V platforms until the new system becomes standard across the product line.

There is no magic bullet. Modern graphical programming is a tricky business, and programming for multiple platforms is even trickier. The results, however, are worth the effort, particularly to the user community. I think that the latest incarnation of Smalltalk/V will spark renewed interest in Smalltalk as an appropriate technology for building portable, user-interface-intensive programs.

There are still more surprises to come. At the 1989 OOPSLA show, an object-oriented database company called Servio Logic showed a Smalltalk application coupled to its GemStone server. What looked to Smalltalk like just an ordinary SortedCollection was, at the other end of a network cable, an industrial-strength database. Now *there's* an architecture for the 1990s.

Jumping Through HOOPS

Now that desktop hardware can do reasonable three-dimensional graphics, there's a large and growing demand for software that can work with 3-D models. The ability to display and manipulate representations of landscapes, machinery, furniture, buildings, and anatomy is revolutionizing a number of engineering and medical disciplines.

One approach to creating portable software for these markets is to build on top of a commercial 3-D CAD package. Most of the leading ones come with tools that you can use to build customized applications. Several, including AutoCAD, MicroStation, and VersaCAD, run on multiple platforms.

Or you could use HOOPS (Hierarchical Object-Oriented Picture System) from Ithaca Software. It's a general-purpose 3-D graphics library, with both C and FORTRAN bindings. It runs on all the high-end Unix workstations, as well as the Macintosh and (with the help of a DOS extender) 386 PCs (a PM version should be available by the time this article sees print). Several leading PC CAD vendors have incorporated HOOPS into the 386 versions of their products to take advantage of its fast rendering capabilities. So it's clear that HOOPS doesn't trade performance for portability.

I've worked with the 386 and Macintosh versions of HOOPS. Central to its architecture is a database of 3-D geometry—points, lines, and polygons—organized as a hierarchy of named segments.

A typical HOOPS program creates a bunch of segments and inserts geometry into them. Then it sets attributes to control things like the size and location of the display window, the orientation of the model, and the method of rendering (wire-frame or solid). HOOPS automatically makes the screen represent the current state of the database, so there's no redraw function to call.

The hierarchical database means that HOOPS programs can be much more flexible than most CAD programs are. The layers that CAD programs typically use to organize models are nothing more than electronic transparencies. While that approach yields the outputs that architectural and engineering professionals require, a hierarchical scheme can better represent complex structure and interrelationships. For example, because a subordinate segment in a HOOPS database inherits the orientation of its parent, a model is implicitly animatible.

This method of organization is the basis of HOOPS's claim to be object-oriented. The program is mainly declarative: It classifies and describes physical structures and lets HOOPS worry about how to display and render them. It must also contain user-interaction code so you can tell the database things like "Turn the model 30 degrees to the left."

HOOPS and You

HOOPS handles the user interface in a fairly heavy-handed way. It wraps its own event loop around the screen, keyboard, and mouse. When you perform a mouse-click, HOOPS provides the name of the segment you pointed to. You can implement a menu by creating segments with names such as `?picture/menu/file`, displaying appropriate text in them (e.g., "File Options"), and setting up the program to react to hits in those segments.

Ithaca Software realizes that it underestimated the GUI juggernaut when it designed HOOPS this way. Although most commercial graphics and CAD programs create their own user interfaces, people really do want standards. There's no shortage of standards to choose from, but it's reasonable to expect a PM, Mac, or X Window program to obey the local conventions.

So, although it's easier to let HOOPS run the show, you can arrange for it to share screen space and event processing with the host's GUI. Fair warning: This is easier said than done. Nevertheless, HOOPS is a remarkable toolkit. If you want to incorporate 3-D geometry into portable applications, you will want to investigate it.

Design Away with Design/OA

MetaDesign, from Meta Software, is an innovative graphical editor that is available on the Macintosh and under Windows and X Window. The editor helps you to build intelligent diagrams made of nodes and connectors. Nodes automatically maintain their connections when they are moved, making hierarchical networks of nodes easy to create and navigate. In fact, a node hierarchy with attached chunks of text acts like a hypertext document.

Although it's easier to let HOOPS run the show, you can arrange for it to share screen space and event processing with the host's GUI.

These features are often found in computer-aided software engineering tools, and MetaDesign is in fact marketed as a cross between a graphical outline processor and an entry-level CASE tool. But that's really just the tip of the iceberg.

MetaDesign grew out of long-term research into systems analysis. The company's founders, experimenting with a formal technique for analyzing concurrent systems, built the graphical toolkit that they needed to create representations and executable models of such systems. That toolkit has two manifestations: MetaDesign, a basic graphical editor, and Design/OA, the open-architecture version for building specialized applications on top of the basic editor.

Meta Software has used Design/OA for vertical-market applications that analyze transaction processing in, for example, the banking industry. Other applications include a graphical interface to a relational database, and a hypertext word processor for programmers.

The R Factor

Design/OA thoroughly insulates you from the underlying operating system and its GUI. Working with the toolkit is a lot like working with a programmable text editor. You're given a fully functional program and access to its primitives, which you can deploy to specialize the program.

The Design/OA kernel handles the main event loop and manages the display of the current diagram. An application can intercept and react to menu choices and other events (such as the double-click) and then pass them along to the kernel (or not). With calls to `DSmenudelete` and `DSmenuadd`, the kernel can customize the default menu system, so an application need not look just like MetaDesign.

Two particularly interesting events that an application might want to capture are the node-creation and node-connection operations. The demonstration program that comes with Design/OA captures them to implement an editor that handles a kind of formal diagram called a predicate/transition net.

The modified editor enforces a graphical syntax: It associates types with nodes, requires you to label nodes and connectors, and implements rules like "a transition node can't be connected to another transition node." Dialogues triggered by the creation of a node gather and store information about the node. Syntax-checking routines monitor all requests to connect the node.

With Design/OA, it's pretty straightforward to add interesting and useful extensions to MetaDesign, and easy to move the results from one platform to another. As with any full-blown programming environment, there's a lot to be learned, and the Design/OA documentation (which essentially consists of a couple of sample programs and an alphabetical list of functions) isn't as much help as it should be. But if an application requires intelligent diagraming and has to be portable, Meta Software is a place to look for one.

continued

Mixed-Network Data Management

With all the fanfare surrounding the new generation of server-based database software, it's easy to sneer at the old-fashioned, workstation-based programs. However, for many applications, it's not necessary to locate processing and data in the same box.

Multiuser databases that rely on simple file- and byte-range locking to synchronize access to shared data can be quite effective. It is true that a server-based application transmits fewer packets, but how many databases used in typical office situations sustain a transaction intensity that is likely to choke a network?

The reality is that multiuser dBASE and dBASE compatibles like FoxBase, though hardly leading-edge, are nonetheless effective toolkits for building applications that manage shared data. When the toolkit spans the PC-to-Macintosh gulf (as FoxBase does), and when you have both PCs and Macs hanging off your network (something that Novell, 3Com, and TOPS all support), things can become pretty interesting.

My XVT project yielded a simple multiuser database that ran almost identically on PCs and Macintoshes. The problem was that it was too simple: It had no indexing, keyed-searching, or data-definition capabilities. One solution would have been a portable database library. But the ones I investigated didn't support locking on mixed PC and Macintosh networks. So I looked into FoxBase, which does.

Environmentally Fit

If you've never seen FoxBase on the Macintosh, you'll be amazed at what the Mac interface does for the stodgy "dot prompt" that the PC FoxBase inherits from dBASE. With multiple browse windows, you can view linked databases side by side. Horizontal and vertical scroll bars make browsing easy. To freeze columns (i.e., make them immune to horizontal scrolling), you just drag a divider from the left margin. The view window displays icons for open databases, and arrows for the relational links between databases. You can even set up links by clicking and dragging.

A typical FoxBase application opens databases and index files and then deploys a couple of tools—the browser and the record editor—under program control. In a multiuser situation, an application should do an RLOCK (record lock) on your behalf if you ask to edit a record, notify you of the success or failure of the lock request, and take the appropriate action in either case.

Fox claims that the code required to do these things ports transparently from the PC to the Macintosh. That's basically true, but I did end up making some adjustments to the application I wrote. The APPEND command on the Macintosh didn't quite work as advertised (although there's an acceptable workaround), and PC-style pop-up menus don't retain their look and feel on the Mac (although you can use the Mac's menu bar instead). Fox's newest PC product, FoxPro, emulates (in character mode) FoxBase/Mac's interface. So the forthcoming multiuser FoxPro should work even more smoothly with FoxBase/Mac.

I'd have preferred the simplicity of identical source code, but the changes were minimal and the end result—PC and Mac users sharing a common database—was well worth the trouble. Imagine the convenience. Whether you're using a Mac or a PC, you have access to the exact same data from both machines. No copies, no keeping multiple versions updated.

I'm no fan of the dBASE language. And I'll agree that the workstation-based architecture that DOS and Macintosh LANs support will, ultimately, give way to a server-based architecture. But there's much that you can do with these basic technologies. And with FoxBase, you can do it portably.

In Praise of Diversity

Walk into a typical office, and you're likely to find an eclectic mix of computers. The fact is, different machines excel at different things. I use a PC and a Mac and wouldn't want to give up either one. I prefer most Mac applications to their PC counterparts, but for writing and programming I'll take the PC with its fast character mode. When X Window-based applications become common, I'm sure they will have their advantages and disadvantages, too.

Using portable toolkits, developers don't have to target one market at the expense of all others, and users can run similar or identical applications on dissimilar machines. This is important now, and will become more important as networks that encompass diverse machines continue to flourish. It enables you to maintain your choice of hardware while staying fully functional within your work environment. Freedom of choice survives. ■

Jon Udell is a BYTE senior technical editor at large. He can be reached on BIX as "judell."

The Highly Decorated General Northgate

A bit pushy? Not at all. General George Patton would, on occasion, walk around with all of his medals in place. So would Generals Douglas MacArthur and Dwight D. Eisenhower when the spirit grabbed them.

And Samuel F.B. Morse, father of an earlier form of communications, before the world became computerized. (If you think we're making this up, check out Morse's be-medaled photo on the back page of this special Northgate insert.) In the meantime, we could go on and on with the reasons to buy a Northgate system, but we thought the awards said it better than we could.

1. PC Magazine "Editors' Choice" award: 80286 SuperMicro. (PC Magazine, January, 1989)
2. PC Magazine "Editors' Choice" award: 80386™ Elegance 20 MHz. (PC Magazine, May, 1989)
3. PC Magazine "Editors' Choice" award: 80386 Elegance 25 MHz. (PC Magazine, May, 1989)
4. PC Magazine "Editors' Choice" award: 80386 Elegance 33 MHz. (PC Magazine, October, 1989) 5. Computer Shopper "Best Buy" awards, three years in a row, based on a vote of the magazine's readers. • Best Buy — complete computer system • Best Buy — overall (all products advertised in the magazine) • Best Buy — Input device: Northgate Omnikey Keyboard.
6. Infoworld. In April of 1989, they saluted Northgate's Elegance 386/25 with the headline: "The Elegance 3000 among the fastest 25-MHz systems" (Infoworld, April 10, 1989). In November, in their review of our Elegance 386/33, they said the following: "Northgate's Elegance 386-33/2000 computer is a top product in most of our scoring categories including value, where it earns just the second excellent mark we've awarded to 33 MHz systems." Overall rating 9.1, their highest ever.
7. PC Magazine "Editors' Choice" award: Northgate's Omnikey Keyboard. 8. "The Northgate Humility award" given to the most modest computer company in Plymouth Minnesota. So there you have it. And the year is still young. Northgate: "Semper Humilis." (Forever Humble).

NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North
Plymouth, Minnesota 55441-41000
1-800-548-1993

Circle 206 on Reader Service Card

Elegance*

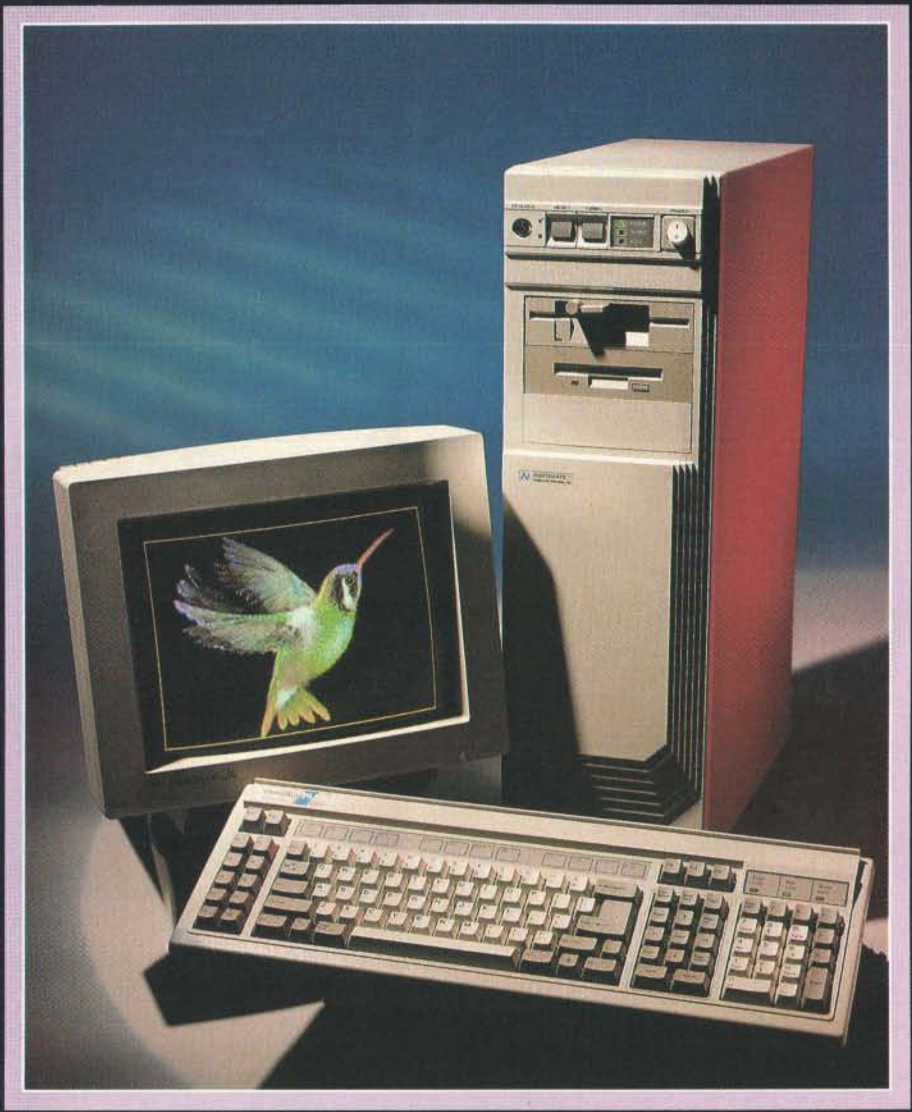


PHOTO: HARRY LANGDON

THE NORTHGATE 386 33 MHz ELEGANCE SYSTEM

*"1a. Refinement and grace in movement, appearance or manners.

b. Tasteful opulence in form, decoration or presentation.

2. Something that is elegant." (American Heritage Dictionary)

You said it.

Since at least three of the medals garnered by General Northgate were for our highly acclaimed Elegance series (triple Editors' Choice awards from PC Magazine, for example), we thought we'd show you what the machine looks like and give you a few specs in case you might be inclined to buy this elegantly designed state-of-the-art computer.

First of all, to photograph an elegant machine . . . you need an elegant photographer. So we went to the most highly respected lensman in Hollywood: Harry Langdon. He normally lights and shoots such famous faces as Linda Evans, Victoria Principal, Cher, Arnold Schwarzenegger and Diana Ross, to name just a few. So shooting a different pretty face like a Northgate Computer is all in a day's work for Harry. For one thing, Northgate doesn't need a hairdresser.

The Elegance series to your left comes in three versions: The 20 and 25 MHz models, and our top of the line/highest performance Elegance: the 33 MHz which earned a 9.1 rating in Infoworld.

The price of the complete 386™ 33 MHz Elegance system pictured: $5995.00. (Of course, you can buy a fully configured Elegance system starting at $3395.00.)

The only thing more impressive than the price is the tech support which comes along with our usual 1 year parts and labor warranty. Did we mention that we also ship you replacement parts, should they be needed, overnight at our expense?

And that our tech support people are actually here for you 24 hours a day, every day, every night?

Put us to the test: give us a call some night at midnight. Or 3:00 AM.

Now to the specs:

Technobabble*

**Seemingly endless Technical specifications, without which you aren't about to buy this machine no matter how many awards it's won.*

Not only that . . . would this look like a real computer ad without them? Probably not. Here they are:

STANDARD CONFIGURATION

- 33 MHz Intel 80386 processor.
- 150 Mb ESDI Hard Drive 16MS.
- 4 Mb Ram.
- 64 K SRam Read-Writeback Cache (Optional 256 K Cache available)
- Zero wait state performance.
- 1.2 Mb—5.25" floppy drive (also reads, writes and formats low density diskettes).
- 1.44 Mb—3.5" floppy drive (also reads, writes and formats low density diskettes).
- Eight expansion card slots
- 80387 or Weitek coprocessor support
- Two serial ports and one parallel port (two with monographics systems)
- 14" Multifrequency VGA Color Monitor 1024x768 resolution with 16 bit controller.
- Sleek new Elegance 7 drive-bay custom vertical cabinet pictured. (Desktop style optional, save $150.00.)
- Exclusive award winning Omnikey Keyboard.

24 Hr 7-days a week tech support: unlimited toll free phone.

Additional Technobabble available upon request

NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North
Plymouth, Minnesota 55441-41000
1-800-548-1993

Northgate Slims Down!

Photographs: Harry Langdon

Slimmer. Trimmer. The world's smallest 386, standing not even as tall as America's favorite diet cola. Obviously Northgate has lost a few pounds.

At least in the 386/20 pictured above. But it hasn't lost anything else. How do we pack a 20 MHz real 386 system with a 40 MB hard drive into this space saving, smallest 386 ever introduced?

We do it.

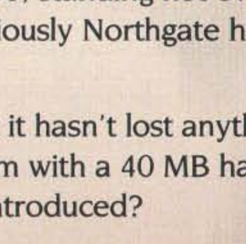
It comes with a VGA monitor and all the usual Northgate guarantees.

Slim price too: $2,499.00 for the entire system. Let's see the competition match this.

Come to think of it...there is no competition. This is one of a kind. A Northgate original. If you're thinking of slimming down, call **1-800 548 1993**, and we'll tell you more about it.

Of course we still make the bigger 386. It's up to you.

Northgate Computer Systems: regular or diet.



NORTHGATE COMPUTER SYSTEMS, INC.
13705 First Avenue North
Plymouth, Minnesota 55441-41000
1-800 548 1993

The Three Greatest Myths:

1. **The world is flat.**
2. **If humans were meant to fly, they'd have wings.**
3. **All 3780 software is alike.**

The fact is, there's one 3780 PC-to-mainframe solution that stands apart.

It's 3780Plus, from CLEO Communications.

Our 3780Plus software is the leading 2780/3780 PC-to-mainframe connectivity solution for EDI, IRS electronic filing, and other data transfer applications.

Supports MS-DOS, VMS, and UNIX/XENIX operating systems.

Users prefer 3780Plus for one simple reason: *It works.* With over 35,000 worldwide installations, it's guaranteed to connect to any major network.

With 3780Plus, you get complete IBM 2780/3780 terminal emulation for IBM PCs, PS/2s, and compatibles. It also works with VAX, HP9000, NCR Towers, and lap-top systems, among others. It supports MS-DOS, VMS, and most leading UNIX operating systems.

Users find 3780Plus easy to install and use. In one fully integrated package, it provides forms control, auto dial/auto answer, attended or unattended operation, and a communications line monitor. You also get our Scripting Command Language (SCL) and Application Program Interface (API).

We offer 3780Plus on high-speed modem boards, high-performance co-processor boards, and economical synchronous interface boards, as well as our intelligent SYNCcable, which links to your host through your PC's serial port.

Works with VAX, HP9000, and other midrange systems, as well as PCs and PS

To learn the facts — just the facts — about our unique, proven 3780Plus solutions, call us today at **1-800-233-2536.** Or write to us at 3796 Plaza Drive, Ann Arbor, Michigan 48108. FAX: 313/662-1965.

CLEO®

CLEO Communications
A Division of Interface Systems, Inc.

Blueprints for the 1990s

IBM's SAA and DEC's NAS both provide interoperability and greater portability across divergent platforms

Sheila Osmundsen

Total applications architectures that create a single environment across multiple platforms don't apply to microcomputers—or do they? They do if the choice of such an architecture affects whether or not you can keep your favorite microcomputer. They do if that choice affects what operating systems you can use. And they do if you're trying to create a more productive environment where changing jobs doesn't involve retraining computer skills.

Currently, two total applications architectures are available, one each from IBM and Digital Equipment Corp. A third one is also in the works (see the text box "An Open Approach" on page 246). IBM, with its Systems Application Architecture, and DEC, with its Network Applications Support, are the major players in this arena. The similarities and differences between SAA and NAS are endlessly debated and will continue to be, for they are IBM's and DEC's software blueprints for the 1990s.

Systems Application Architecture

When SAA was introduced in 1987, IBM was suffering from increasing demands among its customers for compatibility across its divergent platforms. DEC underlined that pressure with its now famous "one operating system" message. DEC could claim a common programming environment across an entire hardware line: the VAX. IBM could not. In addition, the VAX's range of performance was rapidly encroaching on the range that IBM covered with its microcomputer, minicomputer, and mainframe platforms.

SAA is an attempt to provide common ground for a selection of IBM's platforms with the structure shown in figure 1. The platforms are OS/2 Extended Edition (for microcomputers), OS/400 (for minicomputers), and, within its S/370 (mainframe) hardware architecture, the VM/SP and MVS operating systems (subsystems TSO/E, CMS, CICS, and IMS). CICS and IMS, as transaction-processing monitors, are participating systems; only the relevant elements are supported for these.

SAA is divided into three parts: Common Communications Support (CCS), Common User Access (CUA), and Common Programming Interface (CPI).

CCS identifies the following communications options to be implemented across SAA's platforms: Data streams—3270, Document Content Architecture (now MO:DCA [mixed-object DCA]), Intelligent Printer Data Stream; Applications services—System Network Architecture's distributed service, Document Interchange Architecture office system, SNA Network Management

continued

ILLUSTRATION: MIKE HODGES © 1990

Architecture; Session services—LU 6.2; Network control—Low-Entry Networking (Type 2.1 nodes); and Data-link controls—Synchronous data-link control, Token Ring network.

The inclusion of IBM's LU 6.2/APPC (advanced program-to-program communications) interface provides SAA's solution for program-to-program connections between IBM computers. This is the major reason IBM people and others sometimes characterize SAA as an extension of SNA.

CUA identifies the elements of the user interface that must be supported across the various platforms, including keyboard, mouse, stream layouts and palettes, applications flow, and user interaction with applications.

CPI provides a common programming environment for all SAA operating systems. This includes specifying and using an identical set of language implementations. The chosen ones are C, COBOL, and FORTRAN (being implemented in that order), and RPG and PL/I (added to SAA in 1989). In addition, CPI specifies the use of the IBM Cross System Product applications generator and the REXX command-procedures language.

CPI also provides common application programming interfaces (APIs) that specify how to access key services (i.e., programming support), shown in the center of the standard SAA diagram in figure 1. This support includes Presentation Manager (PM), which is the OS/2 Extended Edition implementation toolkit for the Presentation Interface API, and the relational DBMS of each system that supports the Database Interface.

The system services currently announced are as follows:

- Common Programming Interface (Communications): CPI to LU 6.2/APPC on the various platforms, initially implemented in the CMS subsystem of MVS only.
- Presentation Interface: device-independent APIs for CUA-compliant windowing, keyboard, mouse, fonts, and graphics support based on the S/370 Graphical Data Display Manager (GDDM).
- Dialog Interface: CPI for setting up menus, help functions, data requests, and message selections on user screens.

continued

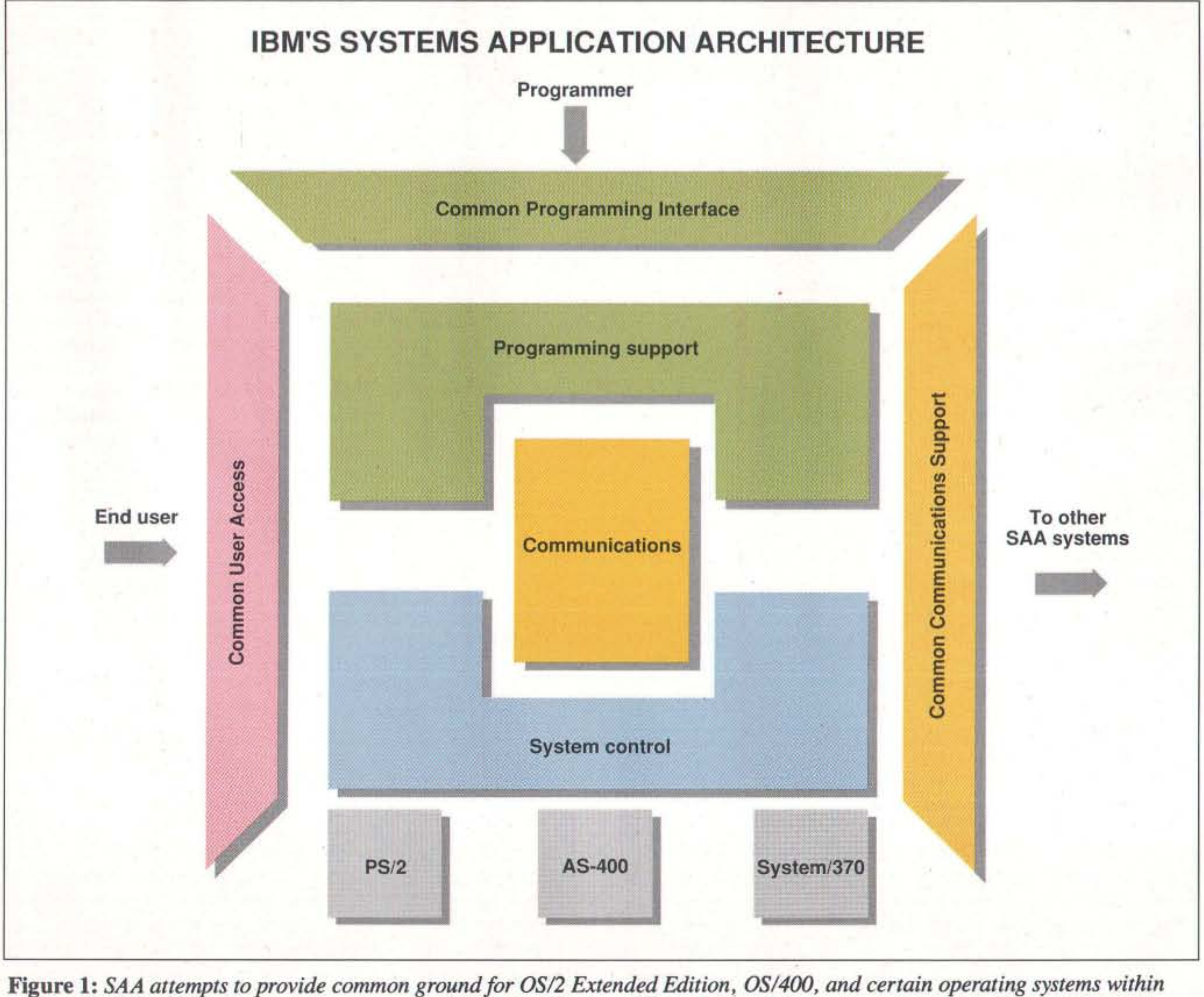
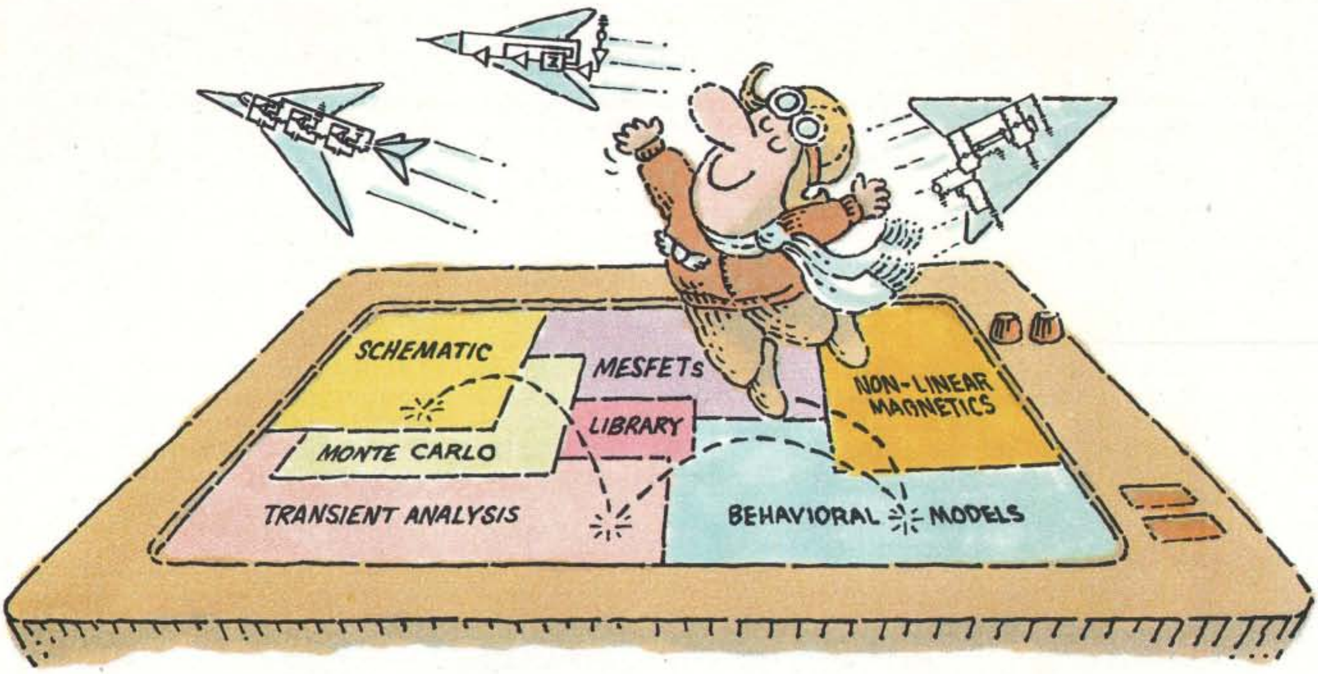


Figure 1: *SAA attempts to provide common ground for OS/2 Extended Edition, OS/400, and certain operating systems within IBM's S/370 line. This diagram shows the standard colors for the different layers. These layers are often referred to by their colors: the yellow layer, the blue layer, and so on.*



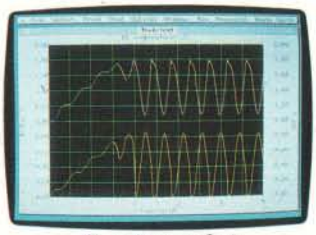
THE NEW MICRO-CAP III.™ SO YOU CAN TEST-FLY EVEN MORE MODELS.

It wasn't easy. But we did it. Made the long-time best-selling IBM® PC-based interactive CAE tool even better.

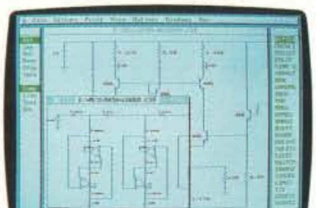
Take modeling power. We've significantly expanded math expression capabilities to permit comprehensive analog behavioral modeling. And, beyond Gummel Poon BJT and Level 3 MOS, you're now ready for nonlinear magnetics modeling. Even MESFET modeling.

Analysis and simulation is faster, too. Because the program's now in "C" and assembly language. That also means more capacity—for simulating even larger circuits.

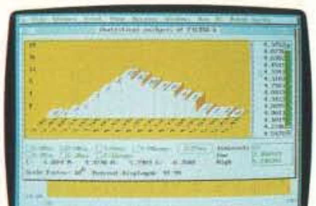
As always, count on fast circuit creation, thanks to window-based operation and a schematic editor. Rapid, right-from-schematics analysis—AC, DC, fourier and transient—via SPICE-like routines. The ability to combine digital/analog circuit simulations using integrated switch models and parameterized macros. And stepped component values that streamline multiple-plot generation.



Transient analysis



Schematic editor



Monte Carlo analysis

And don't forget MICRO-CAP III's extended routine list—from impedance, Nyquist diagrams and BH plots to Monte Carlo for statistical analysis of production yield. The algebraic formula parsers for plotting virtually any function. The support for Hercules, CGA, MCGA, EGA and VGA displays. Output for plotters and laser printers.

Cost? Still only $1495. Evaluation versions still only $150. Brochure and demo disk still free for the asking. Call or write for yours today. And see how easily you can get ideas up and flying.

spectrum

1021 S. Wolfe Road
Sunnyvale, CA 94086
(408) 738-4387

Circle 266 on Reader Service Card

- Database Interface: implemented in Structured Query Language (SQL).
- Query Interface: query and report-writing facilities.
- Repository Interface.
- Distributed Data Management (DDM).

As platform-specific implementations of SAA generally support additional functions, you must use the CPIs with CCS and CUA specifications to ensure applications portability. For example, IBM is redesigning many applications to conform with SAA and may still support some of their original functions as well. If you use nonconforming functions, your application might not be portable to other SAA platforms.

On the other hand, IBM ensures that source code written to the "ordered subset" of functions that SAA supports in the CPIs will endure, whatever enhancements may be made in the future.

IBM has not yet implemented all the elements of SAA: Internal guidelines state that SAA support on one platform must be followed with support on all the other platforms within two years. But SAA is not static. Repository Interface was announced in September 1989, and IBM is planning its first implementation on the MVS operating system for June.

Network Applications Support

While IBM is providing applications integration for its own systems, DEC is going ahead with integrating Unix and providing interoperability with popular desktop platforms—VMS, its proprietary operating system, and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. SAA does not address this mission at all.

As IBM's development of its Unix environment (AIX) has been on a separate track for the first three years of SAA's existence, DEC's Unix support may be an advantage that will stand for some time. But then, strong in technical computing where Unix has its bedrock, DEC

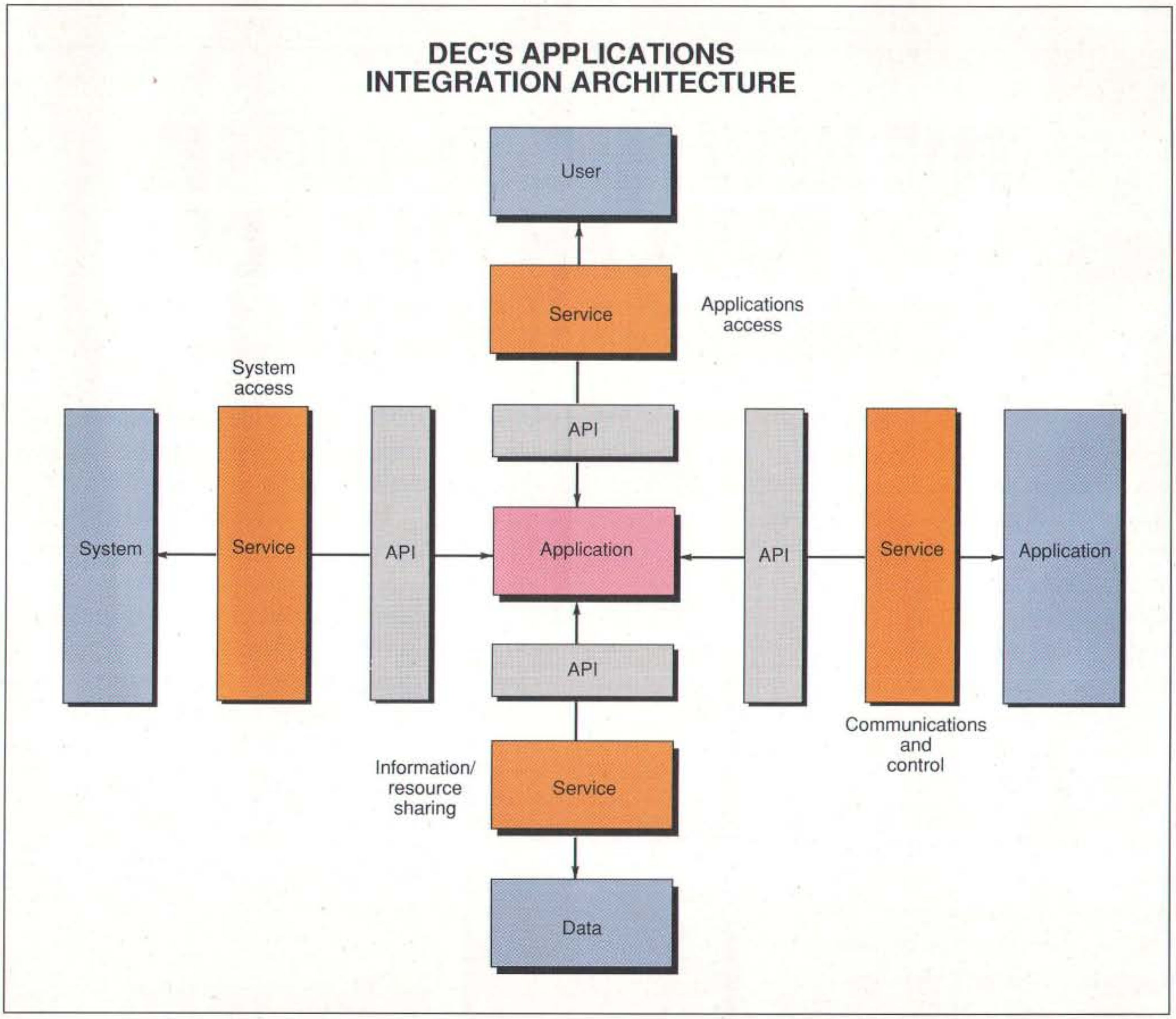


Figure 2: *AIA provides the architectural categories for NAS. NAS attempts to integrate Unix and provide interoperability with VMS and Ultrix workstations, DOS PCs, OS/2 PCs, and Macintoshes. The colors used group like elements together but do not have the significance of the colors in figure 1.*

has had more reason to focus on Unix.

The NAS scheme provides applications on the five platforms mentioned with access to common services that run under VMS and Ultrix. Those services may exist on larger machines or on the VMS or Ultrix workstations. (VMS and Ultrix workstations can perform as servers as well as clients. The other three desktop computers are clients only, although a server role may be in the future for OS/2.)

In addition, DEC claims greater openness for NAS because it is based on de facto and de jure industry standards. SAA's ingredients may or may not adhere to standards: It's not in the charter. However, many of them do, and whatever IBM does is often so widely implemented that it becomes a de facto standard, anyway. Both companies are trying to drive relevant standards in their respective strategies, especially in integrating new technologies for which standards are just emerging.

DEC uses the label Applications Integration Architecture (AIA) to describe NAS architecturally, according to the structure shown in figure 2. However, NAS is the overall term used. The NAS implementations deliver that architecture and map directly to it. The table on page 242 contains the generic designation that AIA supplies for the various pieces of the environment followed by the current names of NAS implementations. Due to NAS's basis in standards, the pieces often match up with various standardization efforts.

Like SAA, NAS reflects much intention as well as reality. For example, DEC's electronic document interchange (EDI) services, although they have been outlined, will not show up until late this year. The slot for Repository services is filled by DEC's Common Data Dictionary/Plus for VMS. Last spring, DEC announced that it will support an API for CDD/Plus based on a draft standard jointly developed with Atherton Technology. The proposed standard is now before standards-review committees.

The API, an Ultrix version of CDD/Plus, and client support for DOS and OS/2 are forthcoming, probably beginning later this year. LiveLinks and Builder in the NAS list are data-link technologies currently offered by DEC in compound-document-architecture (CDA) based applications; DEC plans to make them generic services for NAS.

The System access category also requires explanation. POSIX provides an interface to System services in contrast to the high-level services in the other categories. DEC now supports it in Ultrix, with VMS support to come. This will provide a common portable development environment. The use of POSIX is a possible route to further integration of OS/2 into the NAS scheme, since Microsoft has stated that OS/2 will support POSIX.

Finally, with the sole exception of POSIX, NAS's base in standards does not mean that standard functionality is synonymous with the NAS service functionality. Standardized function is a variably important component of full-function NAS services, depending on how far a standard has progressed. For example, DECwindows was developed on an X Window System (referred to as X Window for the remainder of this article) base and incorporates a look and feel that is slated to migrate to conformance with the Open Software Foundation's Motif, both fully fleshed-out standards.

On the other hand, DEC's CDA implementation incorporates existing open document architecture/open document interchange format standards, as does IBM's MO:DCA, in fact. But those standards are minimal so far. DEC hopes its work in the relevant standards processes will lead to incorporating its technology for tabular data handling and live links, for example, into the standard.

Adherence to industry standards creates an additional dimension to portability and interoperability under NAS that can be significant. The X Window underpinnings of DECwindows, for example, allow a DECwindows user to run a program that supports X Window even if it was written for another system with a different user interface. In addition, the X Window base is portable.

Similarities

SAA and NAS share some generic characteristics. Both provide CPIs that address heterogeneous collections of computing resources. These CPIs allow applications to access the various services that different operating systems deliver. They provide interoperability and greater portability across dissimilar platforms.

In addition, both SAA and NAS are emerging concurrently with new technologies—graphical interfaces, repositories, compound document architectures, and distributed databases. The architectures are important elements in their companies' respective development efforts around new technologies as well as in rewriting programs to bring existing products into line.

Each is a Chinese puzzle of components in various states of conformance. Neither SAA nor NAS is static. New elements are continually being added. The results are often strikingly similar, especially when you consider how far apart IBM's and DEC's recipes for computing were just five years ago.

Differences

Nevertheless, tracking SAA and NAS requires understanding the differences between them. These differences show up in purpose, in structure, and in delivery, partly owing to the unwritten maxim that competing vendors don't completely match capabilities. You don't catch up, you leapfrog and differentiate.

You can summarize the major differences in the following ways.

IBM's SAA provides

- a common applications environment for those IBM operating systems chosen for SAA support; and
- an extension of IBM's SNA to provide a new degree of peer-to-peer communications among those systems.

DEC's NAS uses the company's peer-to-peer networking strength (DECnet/OSI and the Unix-oriented TCP/IP protocols) to provide

- common services to applications running on a variety of desktop platforms, including its own VMS and Ultrix (Unix) workstations, DOS PCs, OS/2 PCs, and Macintoshes;
- a common applications development environment between DEC's VMS operating system and its Ultrix platform; and
- an environment that is based on industry standards.

When comparing the breakdowns of NAS and SAA structures, a difference and possible source of confusion is that DEC names the implementation in which an API is contained. The implementation and the API are separate in IBM's definition of SAA. Like SAA, however, NAS also makes strict distinctions; the API in each instance is inviolate.

For example, in SAA, CUA specifies the graphical user interface, and Presentation Interface is the API for interfacing to PM, IBM's version of CUA for OS/2 Extended Edition. DECwindows, by contrast, is a complete toolkit for graphical interface, akin to PM and incorporating the necessary APIs.

Further, DEC has used various means to implement NAS goals. For example, MS-DOS Display Facility (in table 1) is a

continued

NAS FUNCTIONALITY LIST

The Applications Integration Architecture describes Network Applications Support architecturally. The NAS implementations deliver that architecture. Notice that the pieces of the environment are the same as the services shown in figure 2.

Pieces of environment	Generic AIA designations	Current NAS implementations
Applications access	Windowing services	DECwindows (for VMS, Ultrix) MS-DOS Display Facility
	Forms services	DECforms
	Terminal services	Terminal emulators (all platforms)
	Graphics services	DEC GKS DEC PHIGS
	Application control services	LiveLink Builder
Communications and control	Messaging services EDI services	Mailbus VAX/EDI
Information/resource sharing	Compound document services	CDA Toolkit CDA Viewers CDA Converter Library DECimage Applications Services
	Data access services	SQL Services
	Repository/dictionary services	CDD/Plus
	File-sharing services	VMS Services for PCs NFS for Ultrix VMS/Ultrix Connection
	Print services	DECprint
System access	System services	POSIX interface

separate implementation that allows the DOS desktop to use a DECwindows application, even though its lack of multitasking prevents it from running as a true DECwindows workstation.

When comparing the lists of functions as definitions of an applications environment, some other differences pop up. SAA's specification of many protocols for communications has no parallel in the NAS list. DEC has provided all NAS platforms with support for DECnet and TCP/IP protocols, and applications built on top of NAS services are network-independent. Also, communications functions in the NAS list are built on the underlying network mechanisms.

Apples, Oranges, and Sequels

At this stage in their development, even when equivalent NAS and SAA functions have been implemented, a 1-to-1 comparison is elusive and difficult to generalize from. A close look at one case offered in both frameworks, however—SQL database access—illustrates some of the differences between them. It also shows how similar SAA and NAS can be when they both conform to the same standard.

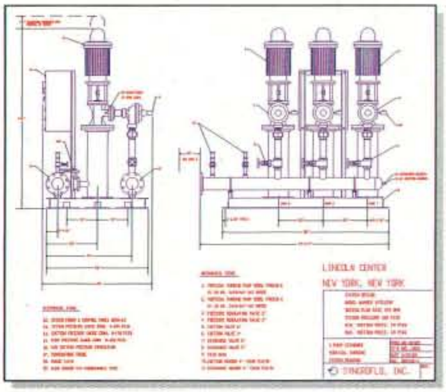
Two comparisons are relevant for clarity. The first addresses DEC's evolving integration of VMS and Ultrix under the NAS umbrella, comparing the current VAX SQL interface for VMS's relational database to SAA's SQL CPI.

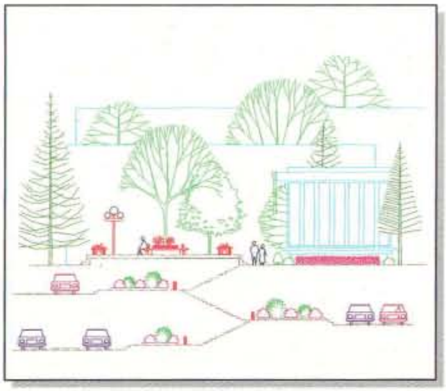
The VAX SQL interface is slated to present a common API to the relational DBMS for Ultrix, which DEC is expected to release this year, based on technology licensed from Ingres. As such, VAX SQL is the strict apples-to-apples comparison to SAA's SQL CPI. Listings 1 and 2 show the almost identical steps required to retrieve payroll information in a C application using the VAX SQL and SAA SQL interfaces.

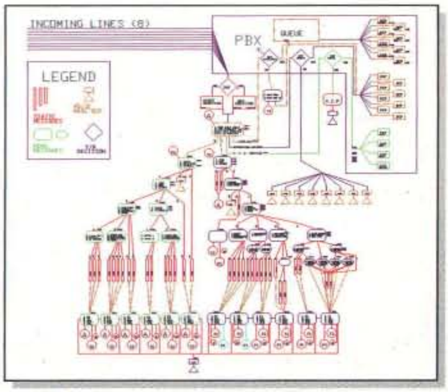
Notably, IBM has been talking about extending the SAA SQL CPI umbrella to embrace its relational DBMS for AIX, for which it initially licensed technology from Oracle. Although this extension would entail communications issues,

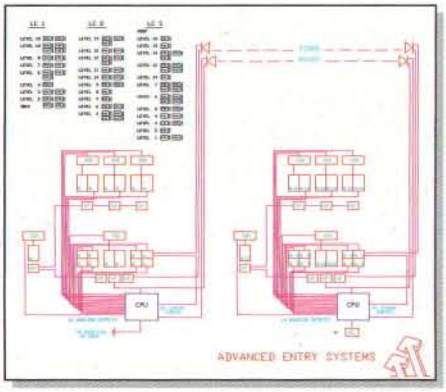
continued

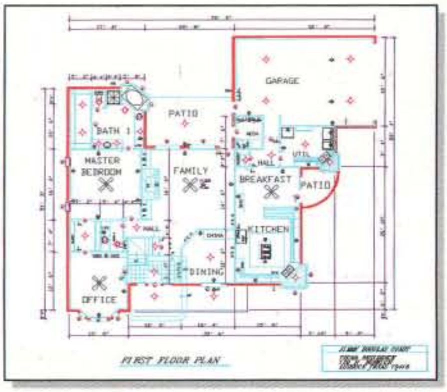
FOR SALE: DRAWING BOARD, T-SQUARE, DRAFTING PENS...BARELY USED.











It's time to consider computer-aided design and drafting (CADD). Join over 200,000 users who create better drawings faster with Generic CADD. From simple floor plans to detailed engineering drawings, there's a Generic CADD solution to all your drawing needs.

Generic CADD.
A better way to draw.

Get started quick with The CADD Starter Kit. Computerized drawing is easier than you think. Create your own drawings and designs in just hours using the Starter Kit's step-by-step tutorials, sample drawings and pre-drawn design symbols.

Draw like a pro with CADD Level 3. Draw blueprints, floor plans and schematics just once... then revisions are just a "stretch," "move" or "copy" away. You can enhance your image while saving time with this precision drawing tool.

Powerful PC CADD starts at under $200. Order either Generic Software program now and you'll receive FREE a copy of the book, "Converting to CADD–A Beginner's Guide to Computer-Aided Design." Just note on your registration card that you saw this offer.*

It's a real bargain. See your local software dealer to buy the right Generic CADD product for you. Or call us at **800-228-3601, ext. 703** (U.S. and Canada) for the dealer nearest you.

Generic
SOFTWARE
AN AUTODESK COMPANY

11911 North Creek Parkway South
Bothell, WA 98011
800-228-3601 ext. 703
FAX 206-483-6969

Circle 126 on Reader Service Card (DEALERS: 127)

Listing 1: *This C code shows the programming required for NAS's SQL Services to access data in DEC's Rdb relational database. Compare this to listing 2. Both programs are in dynamic SQL but use quoted strings to replace user input.*

1. To set up program for SQL communications

```
#include <sqlsrvda.h>
#include <sqlsrvca.h>
#include <sqlsrv.h>
```

2. To declare SQL variables

```
char *assoc_id, *stmt_id;
struct SQLDA *sel_list;
char name[20],ssn[10];
int hours_worked
```

3. To prepare `select` statement

```
sqlsrv_prepare(assoc id,0,
              "SELECT * FROM PAYROLL WHERE PAY = 0",
               stmt_id,0,&sel_list);
```

4. To open cursor

```
sqlsrv_open_cursor(assoc_id,"C1",stmt_id,0);
```

5. To fetch

```
sel_list->SQLVARARY[0].SQLDATA = &name;
sel_list->SQLVARARY[1].SQLDATA = &ssn;
sel_list->SQLVARARY[2].SQLDATA = &hours_worked;
sqlsrv_fetch(assoc_id,"C1",0,0,sel_list);
```

Listing 2: *This C code uses SAA's CPI to access a relational database. It differs from the VAX SQL in the* `stmt.len` *statement, which reformats the input string from C to COBOL format in the IBM case.*

1. To set up program for SQL communications

```
EXEC SQL INCLUDE SQLCA;
```

2. To declare SQL variables

```
EXEC SQL BEGIN DECLARE SECTION;
char name[20],ssn[10];
int hours_worked;
struct {short len;
        char stg[36];
       }stmt;
EXEC SQL END DECLARE SECTION;
```

3. To prepare `select` statement

```
stmt.len = 35;
strncpy(stmt.stg,"SELECT FROM PAYROLL WHERE PAY = 0",35);
EXEC SQL PREPARE SELECT1 FROM :stmt;
```

4. To open cursor

```
EXEC SQL DECLARE C1 CURSOR FOR SELECT1;
EXEC SQL OPEN C1;
```

5. To fetch

```
EXEC SQL FETCH C1 INTO :name, :ssn, :hours_worked;
```

necessitating an interface for LU 6.2 and TCP/IP, it may be one of the first steps IBM takes to merge the separate path of AIX development with SAA.

NAS provides database access from the desktop platforms via SQL Services as client/server software. The emphasis is on relieving the client of as much processing as possible due to the memory and processing limitations of DOS.

As the primary results, NAS's SQL Services omits the use of precompilers and supports only dynamic SQL (rather than dynamic and static SQL, as in both VAX SQL and SAA). Dynamic SQL software analyzes statements at run time, the function that permits ad hoc queries. The server can perform this analysis in the NAS scheme, so you don't have to run a precompiler locally.

Programming for OS/2 Extended Edition queries under SAA is somewhat simpler than programming for DOS using NAS's SQL Services. Still, SAA does not support DOS. In addition, code written to the NAS API for DOS is portable to other supported NAS platforms. So far, DEC supports SQL Services for VMS, Ultrix, and DOS clients.

However, the DOS deficiencies arbitrate unnecessary restrictions on the other two platforms. When DEC provides a common SQL for Ultrix and VMS relational DBMSes, it will probably introduce an unrestricted optional version of SQL Services for those systems as clients. They will remain clients, however. The other ingredient of SQL Services is establishing a session between the desktop and the remote host that has the database.

In SAA, the remote connection is established transparently. IBM plans to incorporate LU 6.2 communications capabilities into its relational DBMSes on all SAA platforms; that is, into Database Manager on OS/2 Extended Edition, into the integral relational DBMS of OS/400, into SQL/DS for VM, and into DB2 for MVS. A catalog and optimizer in each system determine where remote data is located.

In this transparent distributed database-access scheme, a query goes to the local database, which determines the location of the remote database being accessed. At the present time, transparent access is supported only between like systems. From an OS/2 Extended Edition system, the program in listing 2 could retrieve data from a database on another OS/2 Extended Edition system, but not from DB2.

DEC plans to provide a SQL Services API for OS/2 this year. In addition, DEC and Apple are jointly developing Mac support for NAS. Last May, Apple announced that a SQL Services product supplying a VMS server and an API for the Macintosh will be forthcoming.

Both IBM and DEC support the ISO/ANSI X3.135 standard for SQL, each with its own extensions. However, NAS supports some 54 functions compared to 19 in the SAA CPI.

Current Directions

This year, DEC is likely to move a remote procedure call into its lineup. Program-to-program applications have been held back in the past because DEC never provided an easy-to-use API for the sophisticated bidirectional communications services in DECnet. As IBM backs up its new LU 6.2 CPI with more support, such applications will become more attractive, and DEC is expected to jump ahead to incorporate the RPC as a service in NAS.

As the flow of DECwindows and PM implementations from third-party sources increases to more than a trickle, it will be interesting to see if IBM comes out with high-level communications support. This would allow applications on remote systems to open windows on the PS/2s, fulfilling one of IBM's aims: to off-load mainframes from having to do screen management.

It will also be interesting to see how open IBM's protocols will be. Right now, DECwindows, with the X Window base providing that capability across a network, is far more attractive. While SAA leaves you on your own for high-level support, DECwindows allows you a variety of options. In addition to building DECwindows applications, you can build compatible workstations, alternative network services, and applications with a look and feel suited to custom environments.

Keeping Score

How do NAS and SAA stack up in the microcomputer arena? Clearly, at this time and for plans currently in place, DEC has the edge. NAS supports DOS; SAA does not. NAS supports the Macintosh; SAA does not. NAS supports Unix; SAA does not. The tally is not entirely one-sided, however. Both NAS and SAA support versions of OS/2, and both support forms of SQL.

In addition, both IBM and DEC claim adherence to standards, although DEC seems to be more serious about it. IBM is accustomed to being able to influence the setting of standards by brute force: If IBM does it, then it will probably become a de facto standard. DEC is also trying to influence standards in its favor: DEC is intensifying its participation in the industry processes for standards setting.

NAS and SAA show transformations in DEC's and IBM's approaches to the 1990s as the two vendors who most loudly claim the ability to mastermind enterprise-wide computing. They are only just beginning to make their marks. New players are entering the field, and IBM and DEC are still jockeying for position. Keep your scorecards handy. ■

ACKNOWLEDGMENT
Thanks to Harold Lockhart, senior consultant at Technology Concepts, Inc. (Sudbury, MA), for writing the listings.

Sheila Osmundsen is an industry analyst in Boston, Massachusetts, who specializes in tracking DEC and IBM. She can be reached on BIX c/o "editors."

An Open Approach

Herb Osher

In today's multivendor environments, it is difficult, if not impossible, to completely integrate information artifacts—a Macintosh desktop, a Unix mail message, a Lotus 1-2-3 spreadsheet—without trade-offs.

A technical writer, for example, may value the Mac's user-friendly interface, but struggle when accessing data on DOS-based PCs over a Token Ring LAN. A CAD/CAM expert may prize a high-performance Unix workstation for mathematical analysis, but hit a brick wall when trying to include data residing on an IBM mainframe. Although there are many ways to share data in mixed environments, little progress has been made in integrating applications across proprietary systems.

Major innovations in the microcomputer world of the 1990s will most likely come from the development of distributed architectures based on industry standards. In recent years, Data General has been creating such an architecture that targets open systems: Distributed Applications Architecture (DAA).

The Architecture

DAA is a set of written specifications and software products that allows you to integrate distributed applications across mixed environments. It gives you a consistent view of data, applications, and services no matter what machine or operating system you use. DAA is based on the client/server computing model. It's not limited to one hardware or software environment. Clients are portable to a range of operating systems, and servers to new hardware architectures that support Unix V release 3.

The architecture provides an integrated environment for those who write applications to a variety of standards. It also integrates popular shrink-wrapped applications. The standard environments that DAA supports include DOS, OS/2, Unix, POSIX, and the Motorola 88000 Binary Compatibility Standard.

Data General began announcing products based on DAA in 1989. In February, it launched the AViiON family of computers—servers and workstations based on the 88000 RISC chip—and a version of Unix called DG/UX. The AViiON systems comply with the

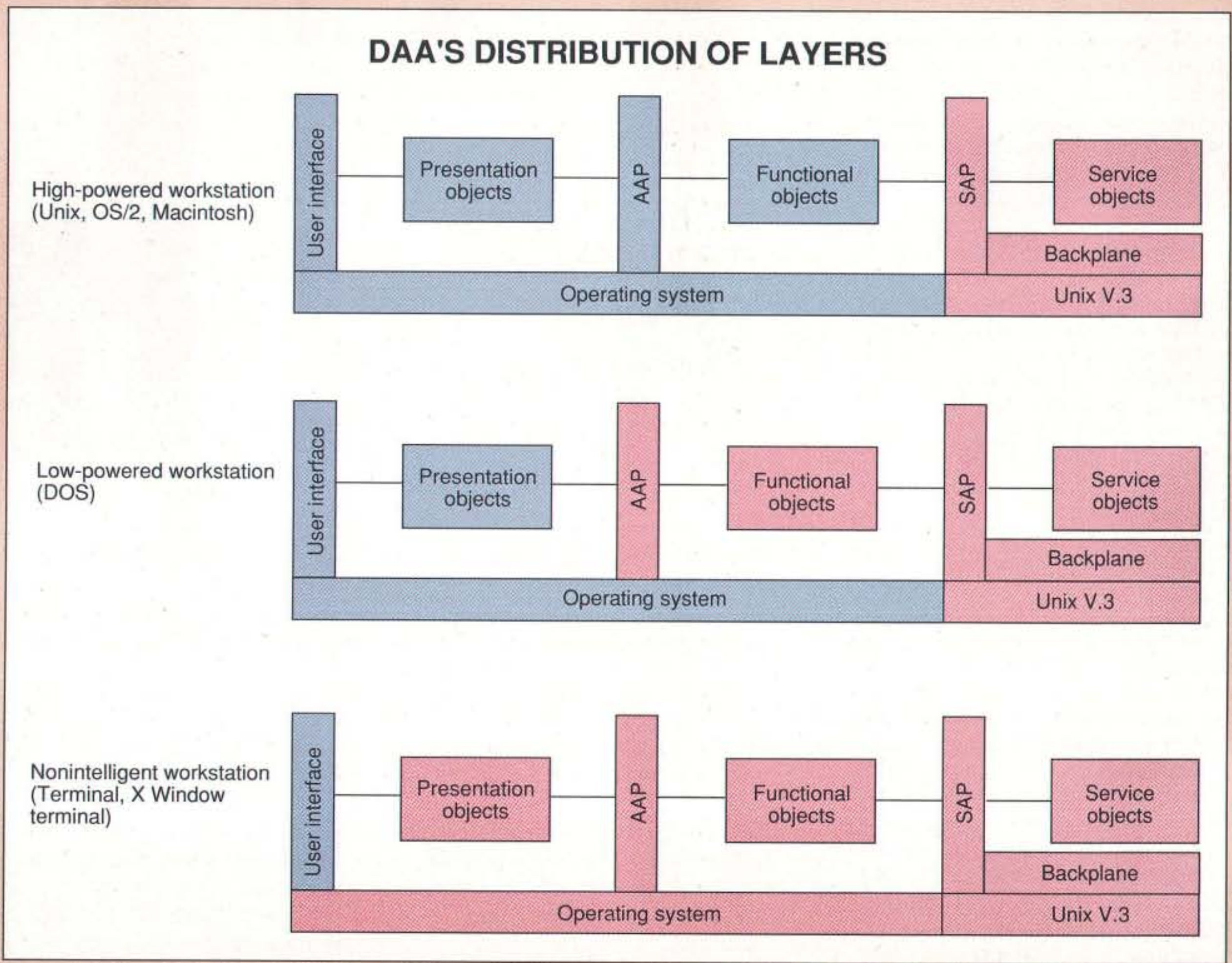


Figure A: *The applications-access point (AAP) and service-access point (SAP) are industry-standard remote procedure calls that allow you to configure DAA for different workstations. Notice how the distribution of layers depends on the sophistication of the workstation used. (The red shows the portion residing on the server; the blue shows that on the clients.)*

88open Binary Compatibility Standard, which ensures applications portability on all 88000-based products.

Built on these RISC and Unix technologies is the most critical component of the design: an open client/server platform that's based on an object-oriented model. DAA's object-oriented facilities support the object-action paradigm, which allows you to select objects and then apply actions to them.

DAA lets you choose your own workstations, network protocols, and database software. The design, from the beginning, centered around distributed object management. Object orientation has been integrated into the client, network, and database components, and object-management services are provided at the presentation, function, and data management levels.

In addition, DAA is a complete implementation of a distributed architecture. This encompasses a backplane of software services (e.g., object database, communications link, name, authentication, notification, and systems management services). Similar to a hardware backplane design, DAA's software backplane allows you to plug in services such as mail, calendar, and print, and to expand to other services when necessary. DAA also provides a set of application programming interfaces (APIs) based on remote procedure calls (RPCs) used to integrate distributed applications across networks.

The Clients

The DAA platform is organized into user communities. It connects clients across LANs and wide-area networks to geographically dispersed servers. This environment can consist of various heterogeneous computing components using a mix of operating systems such as Unix, DOS, OS/2, and the Mac OS.

Clients are *logical workstations* that can run on RISC-based Unix workstations, Macs, PS/2s, PCs, and ANSI and X Window System terminals. The DAA platform provides you with a common user environment across workstation clients using any of the following: Microsoft Windows and Hewlett-Packard's NewWave for PCs; Open Software Foundation's Motif for Unix workstations; Presentation Manager for PS/2s; and text-based menu interfaces for ANSI and X Window terminals. A Mac implementation will preserve the traditional Mac look and feel.

Based on an object-oriented paradigm, the logical workstation includes *functional objects*, such as an in-box object and related methods like read, reply, and forward. Functional objects provide functionality at the applications level and interact with *presentation objects*, which provide a view of the functional objects. In addition, clients can integrate popular shrink-wrapped software as applications-level objects to run on PCs and workstations. A *local object manager* manages these objects.

The client also has access to two powerful mechanisms that leverage functions and services scattered across multiple clients and servers (see figure A). An applications-access point (AAP) allows presentation objects to transparently invoke functional objects that may reside on a client or server. The service-access point (SAP) interface connects the functional objects on the logical workstation with service objects in the object database. The SAP defines the point where the functional objects plug into a DAA server backplane. You can build custom-integrated applications using the SAP interface.

The Servers

The DAA servers consist of communications links, service-providing shared computers, and their peripherals. The server is composed of a service backplane with service objects built on it. It can span more than one physical computer.

At the heart of the object-oriented computing platform is the object database. A component of the service backplane, this database stores all objects, including services. Objects are self-contained units that encapsulate the data and the methods that manipulate it. Object orientation enables DAA to define its objects using high-level abstractions. The database is based on an extension of the SQL model and operates with a range of SQL relational database systems, such as Informix, Oracle, Ingres, and Sybase.

The API available to clients, the SAP, makes RPCs to methods in objects in the database. The DAA platform provides a library of basic objects. It also provides a library of presentation objects that supports a common user interface based on a HyperCard-like model.

The service backplane also houses additional services. An X.500-based name service keeps track of all user names, workstations, and services. Communications links, to allow workstations and services to communicate transparently, are based on industry-standard RPCs, like NetWise. An authentication service enables client and server to authenticate themselves and guarantee secure sessions. A notification service notifies you of changes in status, like new mail. The backplane also houses systems management services for distributing software and managing networks, users, and objects.

The Networks

Users, clients, servers, and the objects associated with them are organized geographically into groups called *domains* and *communities*. Domains and communities provide a home, or address, for these entities and an organization that is the basis for system management.

A domain is a group of users, a list of clients and servers, and all the objects that these clients and servers own. The system can authenticate, register, and centrally manage all users and services within it. A community is a collection of interconnected domains. No central authority controls its members. Rather, a loose federation of domains exists.

As an open architecture based on industry standards, DAA can communicate with other environments. For example, it embraces Data General's Systems Application Architecture communications strategy, which is aimed at compliance with SAA protocols. This architecture allows a meaningful subset of SAA applications to execute in DAA client/server environments. It also provides extensive support for cooperative processing and data distribution between SAA and DAA applications.

At the transport level, the platform is based on Data General's Open LAN architecture, which allows integration over TCP/IP, Novell NetWare, LAN Manager, Token Ring, Open Systems Interconnection, and AppleTalk networks. OSI standards are used as the basis for DAA's naming and management services.

A Single-System Image

DAA presents an open approach to computing in the 1990s. The architecture significantly reduces the trade-offs commonly experienced when you integrate popular operating systems, workstations, interfaces, and applications in today's multivendor environments.

DAA provides much information-processing power, with network-based applications distributed optimally throughout the system. It creates a unified single-system image among heterogeneous computing environments.

Herb Osher is division director of the Office Systems and Distributed Computing Group at Data General Corp. (Westborough, MA). He can be reached on BIX c/o "editors."

Building Blocks

The future course of applications software depends on the interplay of diverse concepts, standards, products, and market forces. For more information on the elements discussed in this section, contact the organizations listed below.

ANSI X3.135 (SQL)
American National Standards Institute (ANSI)
1430 Broadway
New York, NY 10018
(212) 354-3300
Inquiry 1051.

CL/1
Finder
MultiFinder
QuickDraw
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 1052.

DECnet
DECwindows
Network Applications Support (NAS)
Digital Equipment Corp.
146 Main St.
Maynard, MA 01754
(508) 493-5111
Inquiry 1053.

Design/OA
MetaDesign
Meta Software
150 Cambridge Park Dr.
Cambridge, MA 02140
(617) 576-6920
Inquiry 1054.

DESQview
Quarterdeck Office Systems
150 Pico Blvd.
Santa Monica, CA 90405
(213) 392-9851
Inquiry 1055.

Distributed Applications Architecture (DAA)
Data General Corp.
4400 Computer Dr.
Westborough, MA 01580
(508) 366-8911
Inquiry 1056.

88open Binary Compatibility Standard
88open Consortium, Ltd.
8560 Southwest Salish Lane, Suite 500
Wilsonville, OR 97070
(503) 682-5703
Inquiry 1057.

FoxBASE+
FoxBASE+/Mac
Fox Software
134 West South Boundary
Perrysburg, OH 43551
(419) 874-0162
Inquiry 1058.

GEM
Digital Research, Inc.
Box DRI, 70 Garden Court
Monterey, CA 93940
(408) 649-3896
Inquiry 1059.

GemStone
Servio Logic Development Corp.
1420 Harbor Bay Pkwy., Suite 100
Alameda, CA 94501
(415) 748-6200
Inquiry 1060.

HOOPS
Ithaca Software
902 West Seneca St.
Ithaca, NY 14850
(607) 273-3690
Inquiry 1061.

Interface Builder
NextStep
NeXT, Inc.
900 Chesapeake Dr.
Redwood City, CA 94063
(415) 366-0900
Inquiry 1062.

LU6.2/APPC
OS/2 Extended Edition
Presentation Manager
Systems Application Architecture (SAA)
IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
Inquiry 1063.

MS-DOS
OS/2
Presentation Manager
Windows
Windows/286
Windows/386
Microsoft Corp.
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
Inquiry 1064.

NewWave
Hewlett-Packard Co.
3000 Hanover St.
Palo Alto, CA 94304
(415) 857-1501
Inquiry 1065.

Open Look
Unix International, Inc.
Waterview Corporate Centre
20 Waterview Blvd.
Parsippany, NJ 07054
(201) 263-8400
Inquiry 1066.

OSF/Motif
Open Software Foundation
11 Cambridge Center
Cambridge, MA 02142
(617) 621-8700
Inquiry 1067.

Prototyper
SmethersBarnes
520 Southwest Harrison St., Suite 435
Portland, OR 97201
(503) 274-2800
Inquiry 1068.

Smalltalk-80
ParcPlace Systems, Inc.
1550 Plymouth St.
Mountain View, CA 94043
(800) 882-7880
(415) 691-6700
Inquiry 1069.

Smalltalk/V Mac
Smalltalk/V PM
Digitalk, Inc.
9841 Airport Blvd., Suite 604
Los Angeles, CA 90045
(800) 922-8255
(213) 645-1082
Inquiry 1070.

TRON
TRON Association
Tomoe-cho Annex 2
5F, 8-27, Toranomon 3 Chome
Minato-ku, Tokyo 105
Japan
81-3-433-6741
Inquiry 1181.

X.desktop
IXI, Ltd.
62–74 Burleigh St.
Cambridge CB1 1OJ
England
44-0223-462131
Inquiry 1182.

XVT
Advanced Programming Institute, Ltd.
Box 17665
Boulder, CO 80308
(303) 443-4223
Inquiry 1183.

X Window System
MIT Software Distribution Center
Technology Licensing Office
Room E32-300
77 Massachusetts Ave.
Cambridge, MA 02139
(617) 258-8330
Inquiry 1184.

This resource guide lists information sources for the major concepts and products listed in the section. Inclusion in the resource guide should not be taken as a BYTE endorsement or recommendation. Likewise, omission from the guide should not be taken negatively. The information here was believed to be accurate at the time of writing, but BYTE cannot be responsible for omissions, errors, or changes that occur after compilation of the guide.


BYTE
33 MHz
SLA's new
386/32

TIME AND MONEY

In a distributed operating system called Spawn, computers buy and sell time to balance the workload

Peter Wayner

In the world of mainframe computers, time is quite often money. The system administrators often allocate the company computer's time by charging the users more for using the machine in the hours of high demand and less at times when demand is low (like in the middle of the night). Most personal computer users are hardly familiar with this concept because they never have to share their machines. This situation is changing, though, as networks connect many machines.

People with overloaded computers will soon realize that there might be an idle computer on the network that could handle some of the work and lessen the load on their own. The only problem is building an operating system for the network that makes it easy, quick, and efficient to share time.

In the Beginning...

At Xerox's Palo Alto Research Center (PARC), one team of researchers is borrowing the metaphor from the old mainframe system and putting a price on computer time. Their new network, called Spawn, is not just a collection of wires for transferring files; it is a miniature auction economy where machines trade time for a computerized version of cash.

The one big difference between these new networks and the mainframes is the structure of the "economy." The mainframes sell computer time to users at fixed prices and guess how the pricing will control demand. This new system for managing a distributed system of computers is a pure market filled with many buyers and sellers who set prices by bidding for computer time. The result seems to be an ideal way to allocate resources and also, incidentally, to study how markets work.

The basic Spawn system operates on a network of Unix computers running Sun Microsystems' protocols for Remote Procedure Calls (RPC) and accessing a Network File System (NFS). The designers chose Unix and C because they make up the core of an almost universal operating system that can handle multitasking and network computing. They also chose this combination in spite of the fact that much of Unix's power wasn't necessary and a smaller, finely tuned distributed operating system would be more efficient. But they gained ease of implementation and universality in the trade-off.

The structure of Spawn is easy to understand. Each computer runs a resource-managing process that keeps track of the work being done on the machine. If the computer is idle, the resource manager holds an auction to sell a slice of the spare time to another machine on the network. If one of the jobs running on the machine needs more computer time, the resource manager watches for auction announcements and bids at the auctions until it finds the necessary computer cycles. The manager also keeps track of the amount of electronic "cash" that each process has to spend, although the current implementation makes no attempt to guard against fraud or counterfeiting. (Other researchers are developing secure cash systems relying on clever cryptography, but these ideas are outside the scope of this article.)

Finding the Parallelism

Under Spawn, each application must call up the resource manager when it has a task that could be spun off to run on another machine. The programmer must build the intelligence into the application itself so the application can know when it has a bit of computation that can be "spawned" and executed in parallel.

The process is not automatic. Once the application makes the decision, it hands off the procedure to Spawn, which finds another machine to do the work. The program must know how to integrate the information when it comes back.

For example, ray tracing is an application suited for parallel processing (see "The Art of Ray Tracing," February BYTE). The programmer might set up a program, break it up into 100 different sections, hand those 100 different sections to Spawn, and ask it to bid for time on 100 different machines. If 100 different machines are free, the information will come back very quickly. If fewer machines are free, the resource manager will bid on the available time and continue looking until all 100 jobs

continued

ILLUSTRATION: KEN COFFELT © 1990

are finished. (Note that even if there are 100 free machines holding auctions for their free time, the whole job will not get done 100 times faster. The overhead of communication and bidding prevents perfect efficiency. Preliminary test results show overhead has ranged from 7 percent to 10 percent.) The ray-tracing program then reassembles the data into final results.

The jobs Spawn sets up on different machines can vary in intelligence. The simplest subapplications act like black boxes and only report their results after they've finished their work. The more sophisticated ones send information regarding their partial progress to their manager, which examines all their reports and will often send back instructions to the subapplications regarding the best way to proceed.

Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

This interaction is especially useful for solving problems such as the traveling salesman problem—finding the fastest, shortest route to many locations. Different processes could search different routes and, through the manager, keep track of the current best solution.

The subapplications can also recursively create their own subapplications by splitting their part of the problem into small sections. The entire structure of applications and subapplications can form a big tree-like structure in the network. These subapplications get the money to bid for new time from the process, this managing process in turn obtains money from the process above it, and so on. The manager of the top application is responsible for passing enough currency down to the entire tree so that subapplications can buy enough time to finish their tasks.

The strategies used by the top applications to guide their subapplications can be simple or complex. Equal funding is easy to implement, but it's only efficient if all subapplications are performing an equivalent amount of work. The top application, for example, might create several different applications that would each explore a different approach to the same problem. More funding, though, could be allocated to the solution that is more likely to succeed. A better but more complex heuristic for allocating the currency would reward the more successful subprocesses with more cash to spend on more computer cycles. Of course, this method relies on the existence of some measure of relative progress and success.

Bad Code in the Node?

A major advantage of the economic model is its ability to survive disasters such as other computers crashing on the network. A centralized allocation scheme not only must devote a large amount of time maintaining an active list of machines but must not fail itself. If it stopped, every job would be lost. Some other complex distributed systems have provisions for electing a new central processor in the event of a crash. These protocols are complex and time-consuming because the new central processor must either discover the status of the jobs or restart them.

In the Spawn environment, the resource manager does not need to know the operating status of all the machines. When it wants to buy time, it just watches for announcements of new auctions. However, the application itself must watch for trouble. If a machine running a subprocess crashes in the middle of the job, the top process must notice that no results were returned and restart the subprocess by buying time at the next auction. Fault tolerance can be built in by starting subapplications simultaneously on different machines and accepting the results of the first successful subtask. Obviously, if the top manager halts, the entire job will crash as well. The rest of the network, though, will not be affected.

The Auctions

Spawn conducts closed auctions that are clever combinations of open auctions and sealed-bid auctions. Open auctions aren't efficient on a computer network because they can run indefinitely and flood the network with message after message. Spawn requests sealed bids and sells the computer time to the top bidder, but at the price offered by the *second-place* bidder.

Using sealed bids reduces the network load, since they consist of only one message. Setting the price at the second-place bid results in almost exactly the same price as if there were an open auction. (The difference between taking the first and the second price is important. A normal sealed-bid auction charges the winner just what the time is worth to the top bidder alone. Consequently, the price paid is always the largest amount the top bidder is willing to spend—not the equilibrium price obtained when supply balances demand. The second-place bid is the price at which the second-place bidder would have dropped out of an open auction.) Interestingly enough, if there is only one bidder, the slice of computer time is given away gratis because the effective second-place bid is 0.

Each process must use some strategy to decide what to bid. Many of the simple experiments conducted at the Xerox PARC ran with simple processes that bid all their available cash at each auction. In the meantime, they received a constant trickle of money from their manager. The effect of this system is simple and fair. The process with the most cash will win the beginning auction, but eventually the poorer versions will save money and have enough to buy time.

How Spawn Performs

The best measure of the system, of course, is its performance. The team at the Xerox PARC has tested Spawn with a number of different experiments. These tests have revealed a great deal about the fairness, adaptability, and chaotic behavior of the system.

Some experiments parceled out parts of a Monte Carlo simulation to the various machines. (A Monte Carlo process is a testing method for analyzing large, complex simulations by generating random initial conditions and checking the results. For example, a Monte Carlo simulation of a craps game would roll the dice enough to show that the house has a distinct advantage.)

continued

INTERCON IS RAINING FONTS! NOW WATCH YOUR CREATIVITY GROW!

It's a **"PERFECT"** spring day. And you now have all the right tools to make your word processing flourish. The result: professional, eye-catching documents that burst with style! Blossom with creativity! Bloom with impact!

THE "PERFECT" FONT CARTRIDGE FOR WordPerfect!

Like bees with flowers. **"PERFECT"** is made especially for WordPerfect 5.0/5.1 with a technically advanced design. You take full advantage of WordPerfect's capabilities. No waiting for download fonts. No additional printer memory needed.

■ *MORE TYPE SIZES* ■ *Three Popular Faces* ■ *Portrait and Landscape* ■ *Extensive Symbols*

Century 702 and Swiss 721 (Bitstream's® Schoolbook® and Helvetica®) in 6 to 30 point medium, bold, italic.

Prestige Elite in 10 point (12 pitch) to match typewriter style and 7 point 16.66 pitch for spreadsheets.

126 symbols for commercial, legal, scientific, mathematical, and linguistic usage. Symbols are the same size as the font you select.

Operational with the HP® II, IID, IIP, and Canon® LBP 8II laser printers.

$349 MONEY BACK GUARANTEE

If you're not satisfied, send it back within 30 days for a full refund!

For immediate service using MasterCard or Visa

1-800-422-3880 *outside New York State*

(716) 244-1250 *in New York State*

FAX: **(716) 473-4387**

Order 10 **"PERFECT"** cartridges and Intercon will incorporate your logo into your cartridge for FREE!

INTERCON

1850 Winton Rd. S., Rochester, NY 14618

Intercon's font cartridge line includes: **Pro IIP** for the HP IIP printer; **PHont+** for the Epson© EPL 6000, Toshiba© PageLaser 6 and AT&T© 593 printers; **C3** for Data General© CEO/ WordPerfect 4.2 users.

Circle 144 on Reader Service Card

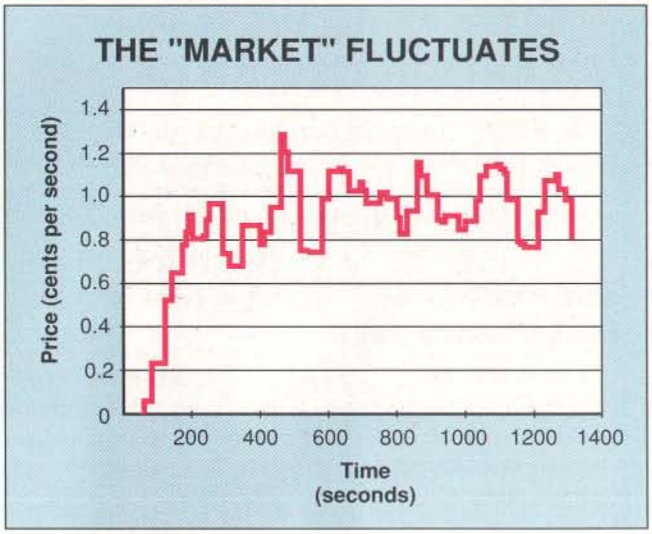


Figure 1: *This graph shows how the price of computer time on the Spawn network fluctuates. Six Sun workstations ran three tasks that were given 30, 20, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs began, the price quickly increased, eventually oscillating at around 1 cent per second. Such chaotic behavior is typical of the economic marketplace on which Spawn is modeled.*

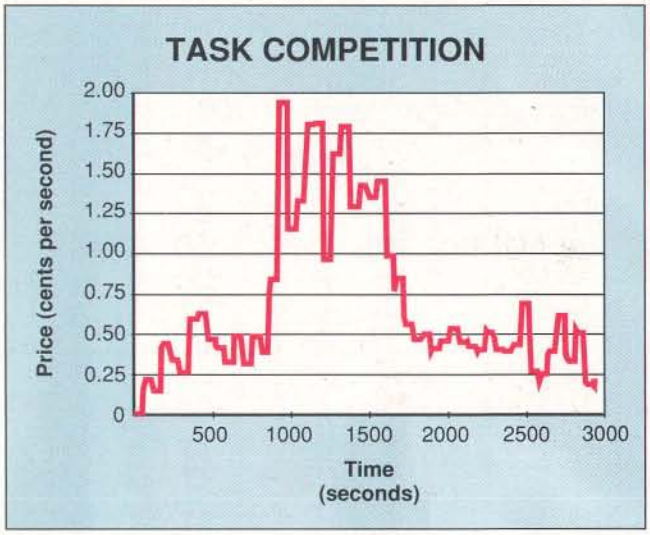


Figure 2: *In this graph, you can see how the price of computing time soars when a high-priority job with plenty of funding enters the market. Two processes with 1 and 2 cents per second to spend begin to lose most of the auctions (at around the 900-second mark) to a process that has 7 cents per second to spend. The price returns to normal when the later process is finished.*

Figure 3: *The price of computing time on different machines is different if the machines have different capabilities. The dark line shows the price of time (established by auction) on the faster and consequentially more valuable Sun-4/260. The gray line is the price of computation on a Sun-4/100.*

The simulations are very easy to split into many sections and run in parallel.

The researchers experimented with various funding strategies. Figure 1 shows the results of connecting six Sun workstations and running three tasks that are given 30 cents, 20 cents, and 10 cents, respectively, every 10 seconds to bid for more computation time. Once the jobs begin, the price quickly increases until it oscillates around an equilibrium price of 1 cent per second.

Because there are six machines, and therefore six auctions conducted, the total money spent per second is, on average, equal to the money flowing to the processes. The fluctuations in the prices shown in the figure are just the first evidence of the random nature of the system. If the same set of programs is restarted, the price graph will be different. The average price will remain the same, but the shape of the price oscillating randomly around this average will be different. The chaos enters the system because the bidding is not linear: Each auction is priced at the value of the second-largest bid.

Team members Bernardo Huberman and Tad Hogg studied a similar system of equations that are easier to analyze theoretically. They discovered that the chaos was often unavoidable when there were delays in communication between computers and each computer's knowledge about the status of the others was incomplete.

The noisy, erratic behavior of the price should be familiar to anyone who plays the stock market. The process is fair, at least to those who subscribe to free-market doctrines, which form the axioms at the foundation of the system. The processes that receive the highest priority are the ones with the most money. In the simulation shown in figure 1, where the ratio of capitalization was 3 to 2 to 1, the allocation of computer cycles was roughly 2.79 to 2.00 to 1.00. The chaotic behavior is probably the cause of the discrepancy between the two ratios.

High-Priority Jobs

The effects of high-priority jobs are easy to see in figure 2. The system begins and ends with two processes (with 1 cent and 2 cents to spend per second). In the middle of the graph, a process starts with 7 cents per second. It quickly begins winning about 60 percent to 80 percent of the auctions, and the price soars. When the job finishes, the price quickly returns to normal. This effect should be familiar to people who watch real markets perform in the same way. (The price of homes in the

continued

San Francisco Bay area, for instance, soared over the last 20 years as the computer industry brought more and more spending money into the area. The price of homes in Houston, on the other hand, collapsed after the price of oil dropped, cutting the flow of money into the region.)

If there are two different machines in the network with different capabilities, different prices will develop. Figure 3 shows the prices of the auctions run on a network of three Sun-4/260s (top line) and six Sun-4/110s (bottom line). The 4/260 is roughly 40 percent faster than the 4/110, and the average prices are quite different. The 4/260 gets more work done, so it is more valuable.

The most important part of the economic model is its support of an easily scalable, very diverse system. A large network will almost certainly not be made up of equivalent machines. Some will be faster than others. Some will have access to special data, and others may have numerical processors suited only for special problems. The value of these systems to all the users will change as they run different programs. If everyone is interested in inverting matrices, then the price of time on the systolic array will be high. On another day, with users running different applications, the time might be free. Dynamic pricing strategies ensure that the network will adapt.

Tying It Up

The chaotic nature of Spawn may seem a bit disconcerting, but, unfortunately, theoretical analysis seems to imply that the chaos is unavoidable. A system with built-in delays and imperfect knowledge seems to lead to chaos. This noise makes it difficult to predict exactly what the network will do. Spawn, though, always seems to behave as intuition might predict. The difficult problem is finding a strategy for bidding that can attempt to watch auction prices and plan intelligently.

Other systems for trading cycles between machines and balancing the network load often behave quite similarly when the Spawn applications bid naively. These other systems are often just economies that use terms like *priority quotient* instead of economic terms. The difference is usually largely semantic.

Setting up a distributed network of computers to share their cycles is a difficult problem that must be solved as networks become more prevalent. The free-market metaphor is not only easy for the mind to understand, but truly useful. Spawn effectively and flexibly allocates computer cycles with a small amount of interaction.

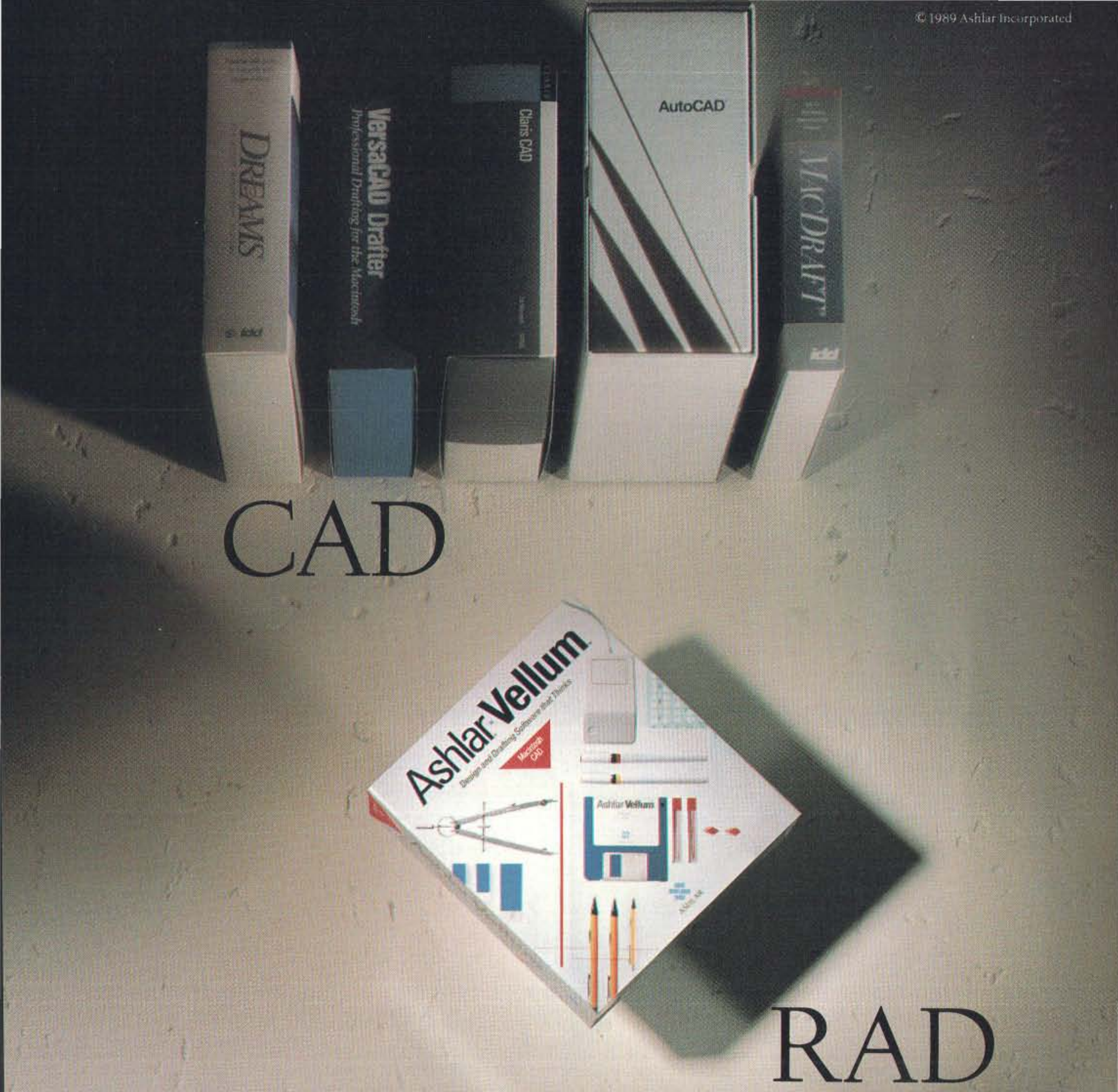
For further reading on the subject, try *The Ecology of Computation* (edited by B. A. Huberman, Elsevier Science Publishing, 1988). This book contains articles about distributed networks, including a piece about a system built at MIT called the Enterprise. In this system, instead of bidding money, the computers bid estimated finishing time. ■

ACKNOWLEDGMENTS

My thanks to Carl Waldspurger, Bernardo Huberman, Jeffery Kephart, Tad Hogg, and Scott Stornetta, members of the Spawn team at the Xerox PARC, for providing background material.

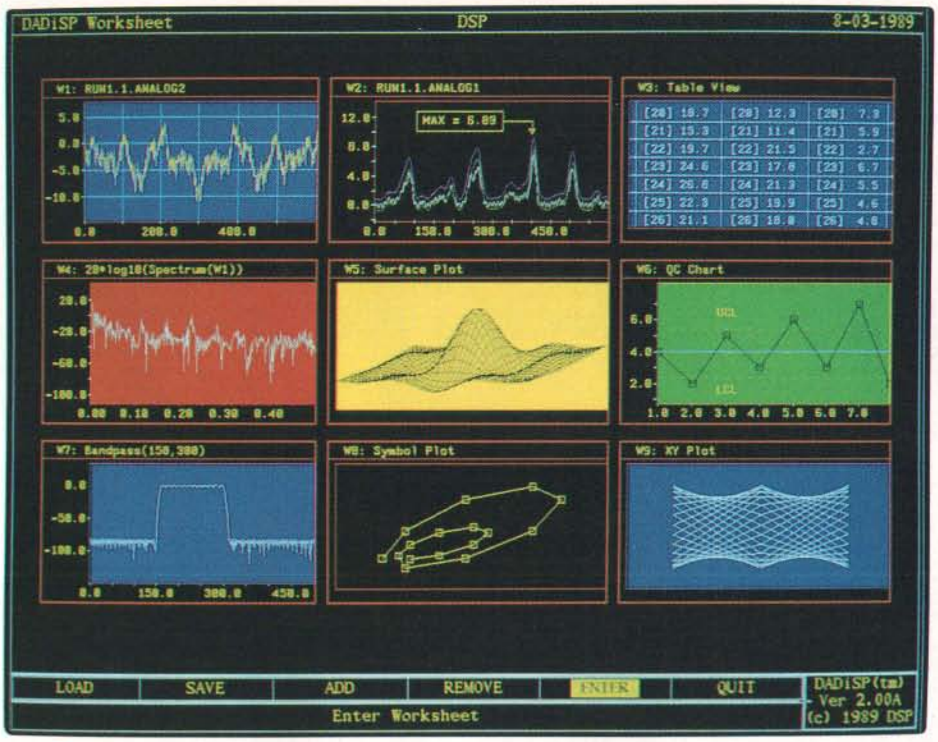
Peter Wayner is reading toward a Ph.D. in computer science at Cornell University. He can be reached on BIX c/o "pwayner."

Circle 201 on Reader Service Card



© 1989 Ashlar Incorporated
DREAMS
VersaCAD Drafter
Professional Drafting for the Macintosh
Claris CAD
AutoCAD
MACDRAFT
CAD
Ashlar Vellum
RAD

Introducing DADiSP 2.0



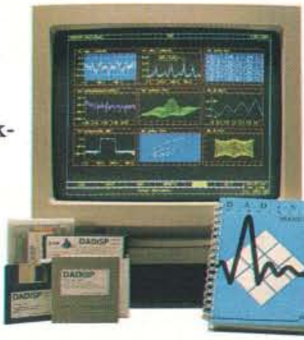
DADiSP. The Big Picture in Data Analysis

DADiSP — interactive graphics and data analysis software for scientists and engineers. DADiSP 2.0 delivers unprecedented power, through easy-to-use menus. Choose from hundreds of analysis functions and graphic views — from tables to 3-D. Simultaneously display multiple windows, each with different data or analyses, for unlimited perspective on your toughest data analysis problems.

Build your own analysis worksheets — build and display an entire data analysis worksheet, *without programming*. And DADiSP's powerful graphic spreadsheet automatically recalculates and updates the entire worksheet if you change your data or an analysis step.

Do serious signal processing...the way you always pictured it! FFTs, digital filter design, convolutions, waterfall plots, and more — all at the press of a key.

Let your instruments do the talking — use DADiSP-488 to bring data from your instruments directly into a DADiSP window for immediate viewing and analysis.



Flexible, expandable, customizable — annotate your graphs and send them to printers, plotters, or publishing packages. Create your own macros, automate routine tasks, and run any program written in any language from within DADiSP. *DADiSP even lets you build your own menus.*

A proven standard — already used by thousands of engineers and scientists worldwide, in a whole range of applications like medical research, signal processing, chemistry, vibration analysis, communications, manufacturing quality control, test & measurement, and more. DADiSP supports the IBM PC and PS/2, SUN, DEC VAX, HP 9000 and Concurrent families of personal computers and workstations.

GET THE PICTURE!
CALL TODAY 617-577-1133

Ask for our Evaluation Disk. For more information, write to DSP Development Corporation, One Kendall Square, Cambridge, MA 02139, or FAX: 617-577-8211.

DSP Development Corporation

Australia-Interworld Electronics, 03 521-2952; England-Adept Scientific, (0462) 480055; Biosoft (0223) 68622; France-SM2I, (1) 34810178; Sacasa, 69077802; West Germany-Datalog, (02166) 46082; Stemmer Electronik, 089-809 02-0; Israel-Racom Electronics 03-491-922; Italy-BPS Computers, (02) 61290221; Japan-Astrodesign, 044-751-1011; Netherlands-Computer Engineering Roosendaal, 01650-57417; New Zealand-GTS Engineering, (09) 392 464; Sweden-Systek, 013 110140; Switzerland-Urech & Harr AG, 61 611325; Taiwan-Advantech, 2-351-211

Circle 99 on Reader Service Card (DEALERS: 100)

NEW OBJECTS FOR OLD STRUCTURES

Converting existing applications to object-oriented applications is possible and often very advantageous

Jeff Duntemann and Chris Marinacci

When you forge ahead to apply new language technology to new projects, existing applications usually get left behind. Writing new applications is fun; converting old ones is just drudgery. Besides, existing applications work already. If they're not broken, why spend the time to fix them?

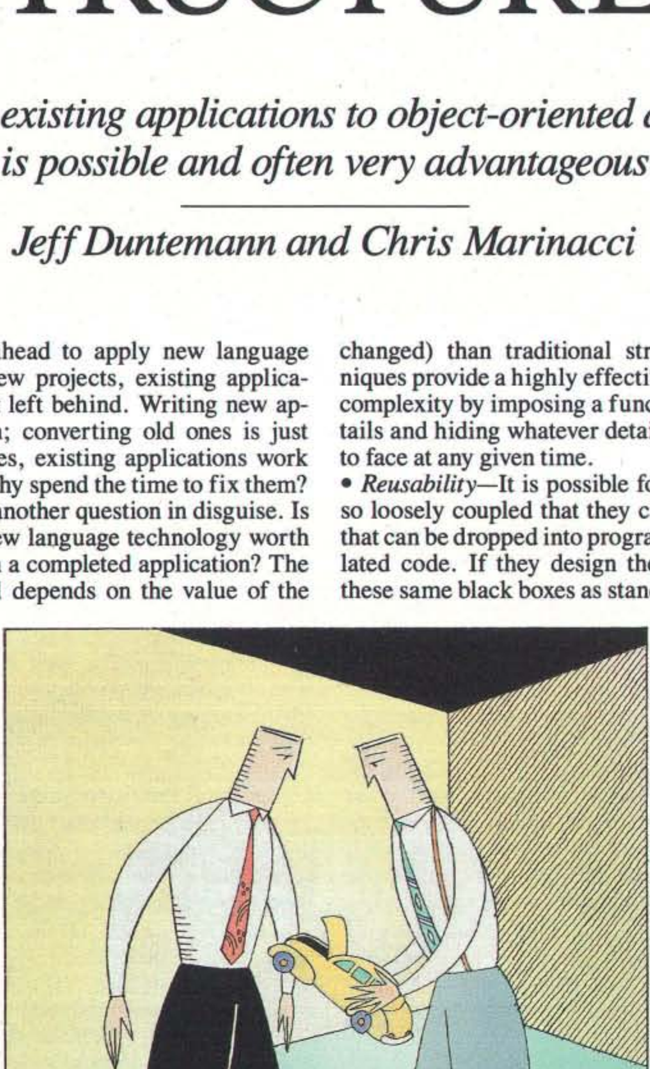
This last question is actually another question in disguise. Is the benefit to be gained from new language technology worth the risk in "lifting the hood" on a completed application? The answer, of course, is that it all depends on the value of the technology.

Ring out the Old; Ring in the OOP

New technology shows up with great regularity in the programming tools business. Still, it's been a long time since anything has generated the excitement that's been created by object-oriented programming (OOP) systems—probably not since the appearance of structured methods in the 1960s. (See "Object-Oriented Programming," February BYTE.)

Is OOP worth the bother?

The answer is almost certainly yes, and the same reasons that apply to new applications also apply to converting old applications:



• *Maintainability*—OOP programs are more easily read and understood (and hence changed) than traditional structured programs. OOP techniques provide a highly effective means of controlling program complexity by imposing a functional hierarchy on program details and hiding whatever details the programmer doesn't have to face at any given time.

• *Reusability*—It is possible for programmers to write objects so loosely coupled that they can be considered "black boxes" that can be dropped into programs with little disruption of unrelated code. If they design them well, programmers can use these same black boxes as standard software parts in future applications, and often with no changes whatsoever.

• *Extensibility*—One benefit of OOP's inheritance concept is that objects can be easily extended with new features without any unnecessary duplication of code. A child object is declared that inherits everything its parent object has and defines only those things that differ from (or must be added to) the parent object.

Weigh Costs and Benefits

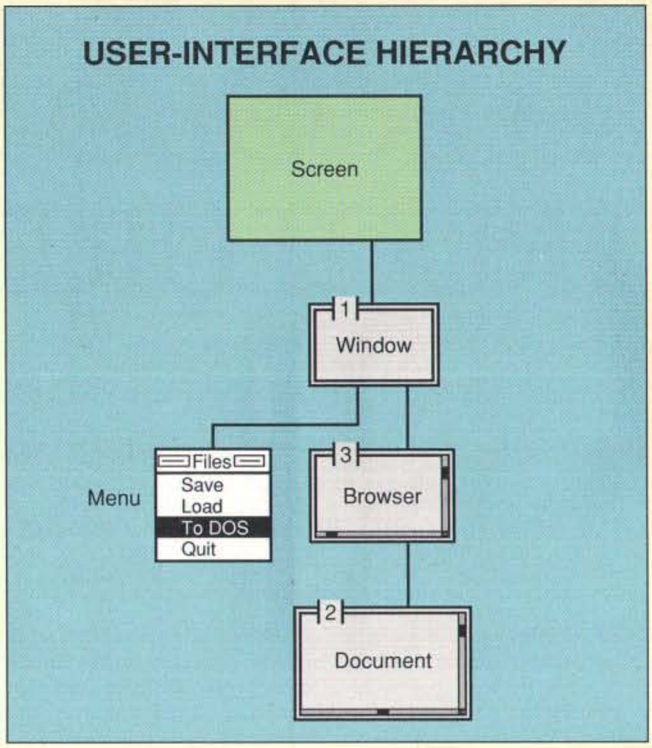
Converting an application involves several important decisions regarding the shape of not only that application, but of applications that will be written or converted in the future. Actually, before developers convert any old applications to object-oriented applications, they should put a

continued

An Object's Heritage

The Screen object type contains all the methods that manipulate the display controller directly. It models the full screen only. The Window object type subdivides the screen with methods to allow sizing, dragging, and border control.

Other screen subsets, including menus and browsers, are children of the Window type. The browser models a read-only editor. It contains methods to manage vertical and horizontal scrolling. The Browser object is an abstract object, meaning that it exists to be inherited from. Its child objects implement specific methods to handle the display of particular types of data—that is, a text browser, a hexadecimal dump browser for memory or files, and so forth.



The Document object inherits the ability to display data to the screen from the Browser type and adds the additional methods needed to edit, search, load, and save text. Note that because the Document object inherits its "frame" from the user-interface hierarchy (see the figure), changing the user-interface objects propagates the changes to the document without any changes to the Document object itself.

Making the application's central object a descendant of the user interface ensures that the application will be consistent with the user interface to the very highest level—that of the application proper.

strategy in place for designing object orientation into future applications. This way, they can spread costs between future development projects and current applications. Developers should, in fact, be thoroughly familiar with these costs before they begin any conversion project. The main costs involve time, tools, talent, and inconvertible applications.

Viable big-picture planning is time-consuming, difficult, and expensive. Without a well-designed hierarchy, there's no way to take advantage of the powers of late binding and polymorphism. But designing the hierarchy isn't easy and can require a level of coordination of efforts among individuals that has never been achieved. The application's architects and support personnel need to be part of the process. Object-oriented conversion is not a small matter to be left to the programmers in the trenches who have been maintaining the code.

In addition, existing development tools may be incompatible with OOP techniques. Older code libraries may not link with new object-oriented modules. Debuggers may not be able to trace object-oriented code, especially where there is heavy use of late binding.

In this early stage of OOP's acceptance, too, OOP talent is still fairly hard to come by, and object-oriented design and programming skills may be a little rough. Training programmers is costly, and staff turnover may greatly retard—or even halt—an important conversion project.

Finally, it's always possible that an existing application may require so much effort to convert that it is better to rethink, redesign, and recode it from scratch using an OOP language that may be completely different from the language currently in use. Applications not written in a structured fashion to begin with, for example, are nearly impossible to recode along OOP lines without a total rewrite.

In general, the higher the coupling between application components—modules, procedures, or whatever—the harder it will be to recode for OOP. Also, code that takes full advantage of system-level resources such as interrupts is hard to meld with true object-oriented code. Some applications convert more easily than others. It's a good idea to know which ones are easier to convert before you begin the conversion process.

Structured Pascal vs. Object-Oriented Pascal

People long assumed that OOP would require new and radically different languages, such as Smalltalk. But over the last few years, major object-oriented extensions to both Pascal and C have shown this concept to be false. Apple published its Object Pascal specification in the mid-1980s. Soon after, Bjarne Stroustrup defined the C++ object-oriented extension to the C language. Since then, effective and efficient object-oriented extensions to structured languages—most notably Objective C, used in the NeXT workstation—have appeared on the scene.

In mid-1989, Borland International extended its Turbo Pascal implementation of Pascal to incorporate objects. The techniques that we'll describe assume the use of Turbo Pascal 5.5, but in broad terms they apply to any language bridge between a traditional language and its object-oriented extensions.

Turbo Pascal implements all three key object-oriented concepts: polymorphism, encapsulation, and inheritance. Polymorphism is the ability of objects to respond appropriately to directives from routines that do not know the objects' exact type. It is accomplished through late binding, which is the determination of call destination addresses at run time rather than at compile time.

Encapsulation is the melding of code and data into a single structure. It is embodied in the object structure, which is defined very much like a record:

```
type
  Point = object
      X,Y : Integer;
      Visible : Boolean;
      procedure MoveTo(NewX,NewY : Integer);
      procedure WhereIs(VAR PosX,PosY : Integer);
      function IsVisible : Boolean;
      procedure Show; procedure Hide;
    end;
```

In an object, data fields like X and Y and methods like IsVisible and Show are defined (encapsulated) together. You can freely access the data fields from outside the record or use the in-place methods that perform all useful manipulations on the data fields.

Inheritance allows a child object to make use of all data and methods belonging to its parent object, while adding or changing only what it must to implement its new features:

```
Circle = object(Point) { Inherits from Point }
    Radius : Integer;
    procedure Grow(GrowBy : Integer);
    procedure Shrink(ShrinkBy : Integer);
  end;
```

A circle differs from a point only in that a circle has a radius. The Grow and Shrink methods are provided to change the radius without directly accessing the Radius data field. All of Point's definitions are directly accessible from Circle as though Circle had defined them itself. In other words, given an instance of Circle named ACircle, the inherited Show method is called by the statement ACircle.Show.

Turbo Pascal objects can override inherited methods simply by redefining them. The compiler knows that an identifier has been redefined when it parses an identifier's second definition; Object Pascal's OVERRIDE reserved word is therefore redundant and unnecessary.

Late binding is implemented by declaring a method as virtual using the new reserved word VIRTUAL. Objects that are descended from one another in an object hierarchy can all share a single virtual method name (like Show), but each can implement that method differently as its individual needs require. Which implementation is actually executed for a given invocation of a virtual method is not decided until run time—hence the term *late binding*. Traditional Pascal procedure calls are *bound* (i.e., the calling logic is given the address of the procedure) at compile time.

Late binding in Turbo Pascal 5.5 makes possible polymorphism (from the Greek for "many shapes"). A single virtual method call can have many shapes, depending on which object type is being called at the moment.

Can You Convert This Application?

Before we discuss how to do a conversion, it's worthwhile to consider which applications may be difficult or impossible to move toward object orientation. You should ask several important questions of any conversion prospect.

Is it structured to begin with? Unstructured applications should be left as they are or totally rewritten. Unstructured Pascal applications make little use of procedures and data structures. Data is scattered across dozens or hundreds of global variables. The main program is large, and loops are often implemented with GOTOs and labels. Many line-for-line ports from older versions of BASIC and FORTRAN end up looking like this, and they tend to be as flexible as concrete.

Object orientation is in one sense a structure of structures. If fundamental program structures such as procedures and records are missing, making it object-oriented might as well be considered a complete rewrite from scratch. Even the specifications may have to be rewritten, as an unstructured spec will be more hindrance than help in writing object-oriented code.

A lesser but related question should be asked of any application. Does anyone in-house really understand it? Old, rarely used, and poorly commented applications should be left alone, or else respecified and rewritten by someone who has never even seen the old application.

The second question is less plain and more troublesome. Does the application or any major part of it depend on non-object-oriented tools? Screen generators that create Pascal code for data-entry modules fall into this category, as do toolbox products consisting of many interrelated procedures and functions that must be linked into the program code. These products are "object-ignorant" and require the application to perform procedure calls and set up data structures in certain ways.

While you can, to a degree, make applications that use such tools object-oriented, the tools will eventually become a source of considerable frustration and will limit the evolution of the object-oriented application along natural object-oriented lines. Furthermore, reusability and extensibility of modules that incorporate non-object-oriented tools will be severely limited or rendered impossible.

First Steps Toward Conversion

Unlike with totally object-oriented languages such as Smalltalk, Turbo Pascal programmers have a lot of choice regarding to what degree an application will be object-oriented. Furthermore, you can convert a traditional Pascal application incrementally without degrading the performance of the application.

The first steps are easy. Remove conflicts with reserved words and predefined identifiers. Turbo Pascal 5.5 adds only four new reserved words to the language: OBJECT, VIRTUAL, CONSTRUCTOR, and DESTRUCTOR. If the application contains any use of any of these words, you must choose new identifiers. There are only two new predefined identifiers that, if at all possible, you should not redefine: Self and Fail. Note that there is nothing in Turbo Pascal's overlay scheme that hinders object orientation. Objects can exist in overlays without modification or special considerations.

Looking for Near-Objects in Old Applications

Programmers are often surprised at how easily they can recast certain portions of an application in object form. The surprise comes from the fact that they sometimes unwittingly create libraries of procedures and functions along object-oriented lines without thinking of them as object-oriented. Often, then, by this time, they have performed everything but encapsulation.

Such "near-objects" usually consist of a data structure or family of data structures and several procedures and functions that act on those data structures. The whole is often defined within a unit, which reduces coupling with other program code and further facilitates "objectification."

One common example of a near-object is a unit that defines a calendar date record and several routines for manipulating

continued

Listing 1: *A long string object type definition produced by encapsulation.*

```
const
  MaxLStringLength = 65521;  { The maximum amount that can be
                               allocated to a pointer }

type
  LStringRange = 0..MaxLStringLength;
  LStringData = array [1..MaxLStringLength] of Char;
  LStringDataPtr = ^LStringData;
  LStringPtr = ^LString;
  LString = object
    Len : LStringRange;          { Current length }
    MaxLen : LStringRange;       { Length that has been
                                   allocated.  This is always
                                   allocated in blocks of 16
                                   bytes so that the long
                                   string's data doesn't have
                                   to be reallocated every time
                                   the long string grows. }

    Data : LStringDataPtr;
    constructor Init;
    destructor Done;
    function SetValue(NewLen : LStringRange; NewData :
       Pointer) : Boolean;
    function FromString(S : String) : Boolean;
    function ToString : String;
    function Length : LStringRange;
    function Copy(Start, Amt : LStringRange) : String;
    function Insert(S : String; Start : LStringRange) :
       Boolean;
    procedure Delete(Start, Amt : LStringRange);
    function Append(S : String) : Boolean;
    procedure Change(Ch : Char; Start : LStringRange);
    function Assign(LS : LString) : Boolean;
    function FromStream(var S : DosStream) : Boolean;
    procedure ToStream(var S : DosStream);
  end;
```

dates. The date record generally contains the date expressed as a month, day, and year value:

```
type
  Date =
    record
      Month, Day, Year : Integer;
    end;
```

Other expressions of the date, such as the DOS time stamp, a slash-delimited string form such as "6/29/89," or a fully spelled-out string form such as "June 29, 1989," are usually calculated and returned by routines defined in the unit. Other useful routines might include a procedure to set a date variable to the current date in the system clock, or to calculate the days between two date values.

```
interface
  procedure SetToToday(When : Date);
  function AsDOSStamp(When : Date) : Word;
  function AsShortString(When : Date) : String;
  function AsLongString(When : Date) : String;
  function AsJulian(When : Date) : LongInt;
  function DayOfTheWeek(When : Date) : Integer;
  function DaysBetween(Date1,Date2 : Date) : LongInt;
```

All these routines can become methods in a date object if you remove the unnecessary parameters (it is assumed that the methods will act on the object's own date data) and place their headers within an object type definition.

```
type
  Date =
    object
      Month, Day, Year : Integer;
      procedure SetToToday;
      function AsDOSStamp : Word;
      function AsShortString : String;
      function AsLongString : String;
      function AsJulian : LongInt;
      function DayOfTheWeek : Integer;
      function DaysBetween(Date2 : Date) : LongInt;
    END;
```

The DaysBetween method retains one parameter and returns the number of days between its own date value and the value of the Date2 object passed as a parameter.

Long Strings as Objects

One of Borland's ongoing research projects during the development of Turbo Pascal's object extensions was the creation of the TurboCalc spreadsheet program. One near-object identified during the specification process was the long string type (capable of storing up to 64K-byte characters) used by the spreadsheet.

In a way similar to the date example presented earlier, a long string was originally implemented as a record containing the string length and a pointer to an array of characters containing the string data. A suite of functions and procedures performed the necessary manipulations on the string record: insert, append, copy, return length, and so on. Encapsulating the data from the original record with the procedure definitions of the routines that acted on the data produced the long string object type definition shown in listing 1.

Recasting utility libraries as objects provides some immediate benefits. In almost all cases, the resulting objects are more loosely coupled than the original library. This reduction in coupling allows their reuse in other applications that are either being converted or under development. Creating objects from utility libraries confers future benefits, as well. Long after their creation, objects can be easily and efficiently extended by creating child objects from these objects. Inheritance confers all the parent's code and data on the child object while allowing the child object to change only that code and data that differ from the parent type.

Identifying the Central Object Within an Application

At the core of most applications of any consequence is a large and often complex data structure representing the work that the application does. For a word processor, this is the document that is often created as a linked list of text lines on the heap. For a database, it may be a binary tree or some other system of records and indexes tied together through pointers. For a spreadsheet, it is usually some kind of sparse array held together with pointers.

This data structure is the essence of what goes on in a program, and all the rest of the code in the program serves it in some way. However the data structure is represented, it should become an object during conversion. The trick here is knowing what code belongs to this central object and what code belongs elsewhere in the program. The identification process is one of "drawing a line around the object," including the code that works with the data structure directly and excluding the code that performs other tasks.

This process sounds simpler than it is, especially when you consider that large objects can (and should) manage their own complexity by containing other smaller and simpler objects. A word processor document is a good example. Most word processors express a document as a linked list of text lines. Each line is a string, and strings are excellent candidates for objectification. The string object should contain the methods for managing string data within the string. The document object should leave manipulation of data within the strings to the string objects themselves and concentrate on managing the relationships of the strings to one another. These relationships include data that flows among strings, say, during the reformatting of a paragraph.

Obviously, drawing this line becomes a lot easier when you have some plan for an object hierarchy in mind. One of the knottiest problems is that of drawing the line between the data structure and the user interface. In order to achieve speed in displaying data to the screen, the central data structure is often very tightly coupled to the display routines. This tight coupling makes isolating the user-interface objects as a separate (and easily reusable) hierarchy much more difficult.

One way around this problem is to make the central data structure a child object of the user-interface hierarchy (see the text box "An Object's Heritage" on page 262). The browser object would presumably have a `redraw` method, which could be overridden by the data structure object with a method that displays the data structure to the screen or window. Don't be afraid to make the central object of the application a descendant of the user interface: The object inherits the ability to present itself to the user according to the rules you have established for your applications.

There are nonobvious benefits to this procedure, as well. If you have a windowing system in which you can create and display a new window at will, making the document or spreadsheet object a descendant of the window object means that splitting the screen into as many documents or spreadsheets as you need is as easy as instantiating a second document or spreadsheet object. The screen-splitting code is right there, inherited from the parent user-interface object.

Incremental Conversion

As you develop object-oriented subsystems for new applications, try grafting them onto old applications under conversion. The tremendous advantage of an object-oriented subsystem is that it is completely decoupled from the application itself. Assuming it doesn't conflict with any existing subsystems within the application, you can add a proven object-oriented subsystem as easily as linking it in and calling its methods.

The hardest part of such a graft might in fact be stubbing out or removing procedures and functions made obsolete by the new subsystem. Watch out for any and all unexpected side effects. Coupling is a snake with an infinite number of heads.

The Application as Object

As you work with OOP, you might get used to thinking of applications as containers for objects. But why not design applications that *are* objects? The entire application then becomes reusable as a component part of larger systems.

Such an application-object might have only two methods: `Activate`, which initializes and executes the application, and `Deactivate`, which "cleans up" any resources used by the application and returns control to the execution platform, which might be a DOS shell. Additional methods to export data to a clipboard for exchange with other applications would be right in line with the object philosophy.

Paradoxically, this forward-thinking conversion strategy is one that you might apply to old applications that are too unstructured or too poorly understood to be converted any other

continued

way. Putting an object "wrapper" around the entire application might be considerably easier than attempting to convert its tangled innards.

If you use this scheme, a word processor becomes a document object, and an accounting application becomes a ledger object. A hidden benefit of this scheme is that the ledger object could become a field in a database, as could a spreadsheet object or document object. Similarly, a document might become a cell in an object-oriented spreadsheet, subject to formulas that might return the document's size or time stamp or even a Boolean flag indicating whether the document contains certain patterns.

Guidelines for Conversion

Converting a traditional application into an object-oriented one is not an all-or-nothing proposition. You can convert incrementally and go as far as time and energy—and the design of the original application—allow. Here is a simple strategy for conversion:

- Find the near-objects in the application and make them objects, ideally set off in a separate module. These near-objects would include string objects, time and date objects, and so on. Performing this procedure is a good way to learn object-oriented techniques when starting from scratch.
- Establish an object-oriented hierarchy plan for future applications. This process involves high-level planning of a user interface, a help system, on-line tutorials, and other relatively application-independent and reusable subsystems.
- With the hierarchy in mind, return to the application being converted and identify the central data structure. Recast the data structure as an object, separating it as much as possible from the other subsystems, such as the user interface and help system.
- As you develop other object-oriented subsystems for future applications, try to add them to the application being converted. This step may involve a lot of rewriting if the original application is object-unfriendly. The amount of programming time you can reasonably allow for the project will dictate the amount of rewriting that takes place.

Watch out for some pitfalls. First, don't get overzealous and try to turn simple data types into objects. Leave characters, enumerations, numeric types, and Booleans as they are. Simple types are treated specially by the language in numerous ways, most of which are lost when the simple types are surrounded by an object framework. The benefits gained by turning simple types into objects are not worth the complication and loss of flexibility.

Don't use virtual methods unless late binding is necessary. Static method calls are identical in speed and overhead to ordinary procedure calls. Moreover, Turbo Pascal's smart linker will strip out any static methods that are never called within an application, reducing the application's code size. Because calls to virtual methods are not known to the compiler at compile and link time, they cannot be stripped out.

Don't design an object hierarchy to accommodate the quirks of a non-object-oriented application. Reusing such a hierarchy in future development will carry those quirks into all your future applications. Instead, wipe the slate clean and design your hierarchy for the future, and then put as many resources as you can afford to into rewriting the old application to adhere to the principles of a fully object-oriented design.

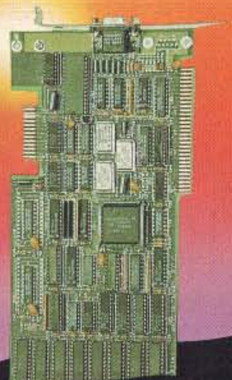
Keep in mind that change for the sake of change isn't the goal. You make an application object-oriented to obtain certain benefits, but the process involves trade-offs. After taking a good hard look at your existing application, you may correctly decide that the benefits aren't worth the costs. The danger here is that you may base your decision on too little information and have too little experience in OOP.

Write at least one fully object-oriented application before you attempt to convert an existing application. Give the conversion process a chance. The compelling benefits of object-oriented techniques turn up in surprising places. ■

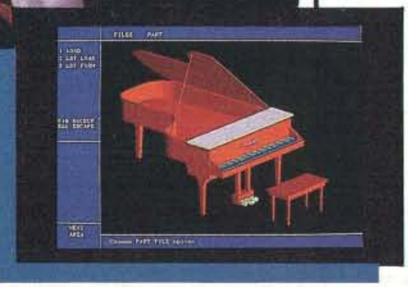
Jeff Duntemann is the former editor of Turbo Technix, *the Borland language journal. Currently, he is a freelance writer focusing on the programming industry. Chris Marinacci is development coordinator for Turbo Debugger and Turbo Assembler at Borland International. They can be reached on BIX c/o "editors."*

Aurora 1024™

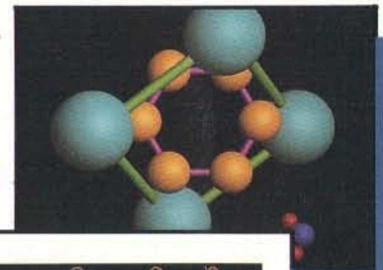
GRAPHICS BOARD



THE DAWN OF A NEW GRAPHICS AGE



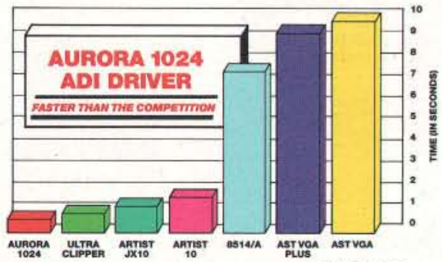
TI 34010 COPROCESSOR
8514/A COMPATIBLE BOARD
1024 x 768 with 256 COLORS!



The Aurora 1024™ brings the graphics user into the new age of graphics processing. By adding the Aurora 1024 high resolution graphics card to your XT or AT, you will have unparallel processing power with 100% IBM 8514/A compatibility. The Aurora 1024 is a full-featured TI 34010-based board that runs at resolutions up to 1024 x 768 x 256 colors.

HIGH SPEED

The Aurora 1024 is fast! It runs 20-50 times faster than VGA and 10-50% faster than IBM's 8514/A. But that's not all! With the specially designed ADI driver, you will see AutoCAD redraw 20 times faster than IBM's 8514/A and other industry-leading boards (as shown below).



WIDE COMPATIBILITY

With the Aurora 1024, you also get industry-wide software compatibility. That's because IBM's new graphic standard, the Adapter Interface (AI) used for the 8514/A, is included with every board. And for AutoCAD users, we also include our specially designed ADI driver—as well as the hottest performing Windows and VENTURA driver available. These interfaces give ready access to a wide range of important non-CAD application programs, such as Lotus 1-2-3®, Wordperfect®, Quattro®, PS/RIO®, PS/TOPAS®, EXCEL®, EnerGraphics™ and Pagemaker® ... plus hundreds of other titles.

AFFORDABLE PRICE

The Aurora 1024 sets a new standard of value and performance at about half the price of most comparable high-resolution graphic boards. You simply won't find a better price anywhere! **$995**

ORDER TODAY

CALL TOLL FREE
1(800) 325-0174

ENERTRONICS

Innovator in Graphic Solutions

nertronics Research, Inc. • #5 Station Plaza • 1910 Pine Street • St. Louis, MO 63103 • (314) 421-2771

Circle 107 on Reader Service Card

Compuclassics

Spring Has Sprung... And So Have Our Deals!

PLEASE CALL US FOR PRODUCTS NOT LISTED. WE SHIP TO APO & FPO ADDRESSES. CALL US FOR A FULL CATALOG.

Monthly Specials in Green. Prices good while supplies last

ACCOUNTING & PERSONAL FINANCE

Dac Bonus Pack 4.0	$175.00
Peachtree III w/ Data Query	$229.00
Quicken 3.0	$39.00
Ronstadt's Financials	$115.00
Turbo Tax Personal	$45.00
Turbo Tax Professional	$229.00

CAD

Autosketch 2.0	$95.00
Design Cad 3D 2.2	$205.00
Design Cad 4.0	$155.00
Generic Cadd Level 3	$165.00

COMMUNICATIONS

Carbon Copy Plus 5.2	$115.00
Close Up Support 3.0	$165.00
PC Anywhere III	$69.00
Procomm Plus	$52.00
Smarterm 240 3.0	$199.00

DATABASE

Clarion Professional Developer	$399.00
Dataease 4.2	$485.00
Foxpro Single User	$479.00
PFS Professional File 2.01	$209.00
R & R Code Generator	$109.00
R & R Relational Report Writer	$115.00
RBase For DOS	$465.00

DESKTOP PUBLISHING

Bitstream Fonts (each)	$95.00
Flowcharting II Plus	$135.00
Freedom Of Press	$259.00
Go Script Plus Ver. 3	$199.00
Go Script Ver. 3	$99.00
Gostyles - Lasergo	$149.00
Interactive Easyflow	$109.00
Per:FORM 2.0	$169.00
PFS 1st Publisher	$89.00
Power Up! Express Publisher	$89.00
The New Print Shop	$39.00
Ultrascript PC 2.0	$119.00
Ultrascript PC Plus 2.0	$269.00
Ventura Publisher	$549.00

EDUCATION & ENTERTAINMENT

ATI Teach Yourself Series	$59.00
F19 Stealth Fighter	$45.00
Flight Simulator 4.0	$45.00
Individual Training Series	$40.00
King's Quest (each)	$35.00
Leisure Suit Larry III	$39.00
Simcity	$35.00
Tetris	$22.00
Vette!	$32.00
Where ... Is Carmen San Diego	$30.00

GRAPHICS

Autodesk Animator	$189.00
Deluxe Paint II Enhanced	$89.00
Freelance Plus 3.01	$349.00
Graphwriter II	$309.00
Harvard Graphics 2.13	$319.00
Inset Plus (w/HiJaak)	$139.00
PC Paintbrush IV	$65.00
PC Paintbrush IV Plus	$119.00
Pizazz Plus 1.3	$69.00
Show Partner FX 3.5	$229.00

HARDWARE & PERIPHERALS

Copy II Option Board Deluxe	$115.00
Intel Above Board Plus 512K	$435.00
Logitech Bus Mouse C9	$85.00
Logitech Scan ManPlus	$185.00
Logitech Serial Mouse C9	$65.00
Logitech Trackman Serial or Bus	$89.00
Masterpiece	$89.00
Masterpiece Plus	$105.00
Microsoft Mouse w/Paint	$109.00
Orchid Prodesigner Plus 512K	$349.00
Pacific Data 25-in-one	$289.00
Pacific Data Pacific Page	$509.00
Paradise VGA 1024-512	$305.00
Polaroid Palette Plus (EGA)	$2,399.00
Prac Periph 2400 Ext w/MNP	$209.00
Prac Periph 2400 Int w/MNP	$179.00
Sota 286i Accelerator	$259.00
Sota 386i Accelerator	$399.00
Super Cartridge 1 -IQ Engineering	$275.00
Super Cartridge 2 -IQ Engineering	$449.00
Worldport 2400 Modem	$249.00
Worldport 2400 Modem w/ MNP	$345.00
Worldport 2496 Fax Modem	$485.00

INFORMATION MANAGEMENT

Agenda	$275.00
askSam	$175.00
Grandview	$199.00
Tornado W/Library	$79.00

INTEGRATED

Alphaworks	$115.00
Smartware II with Spell Checker	$469.00
MS Works 2.0	$95.00
Q & A 3.0 (Networkable)	$245.00
Symphony Plus	$475.00

LANGUAGE & PROGRAMMING

Brief	$159.00
BTrieve	$159.00
C Asynch	$119.00
Macro Assembler	$99.00
Matrix Layout 2.0	$135.00
MS C 5.1	$299.00
MS Fortran	$299.00
MS Quick C w/ Quick Assembler 2.01	$135.00
Object Professional	$109.00
Qbase	$149.00
Quick C	$67.00
Quickbasic	$67.00
Smalltalk V286	$129.00
Sourcer w/Bios	$109.00
SPF/PC	$159.00
Turbo Asynch +	$119.00
Turbo B Tree Filer S/U	$79.00
Turbo C Pro Pack	$175.00
Turbo C Tools	$92.00
Turbo Pascal 5.5	$105.00
Turbo Pascal Pro Pack	$165.00
Turbo Power Tools Plus	$92.00
Turbo Professional	$79.00
Zortech C ++ 2.0	$149.00

NETWORKING

Lantastic Starter Kit 2MBPS	$409.00
NE1000 Ethernet Card	$169.00
NE2000 16 Bit Ethernet Card	$205.00
Novell ELS Level II 1-8 User	$1,175.00
Novell SFT V 2.15	$3,099.00
Western Digital Ethercard Plus	$189.00

OPERATING ENVIRONMENT

Desqview	$79.00
Desqview 386 1.1	$125.00
IBM DOS 3.3	$95.00
IBM DOS 4.01	$119.00
MS Windows 286	$67.00
MS Windows 386	$129.00
OS/2 Standard Edition 1.2	$269.00

OS/2

Excel for OS/2	$335.00
Logitech Multiscope	$185.00
MS OS/2 Presentation Mngr Toolkit	$329.00
Wordperfect for OS/2	$319.00

PROJECT MANAGEMENT

Adv. Project Manager Workbench 3.05	$845.00
Harvard Project III	$465.00
Scitor Project Scheduler IV	$429.00
Timeline 3.0	$409.00

SCIENTIFIC / STAT

Brainmaker	$149.00
Derive	$130.00
Mathcad 2.5	$305.00
Mathematica 386 w/387 Support	$845.00
Statgraphics	$579.00
Systat w/ Graphics	$509.00

SPREADSHEET

Lotus 1-2-3 Ver. 2.2	$349.00
Lotus 1-2-3 Ver. 3.0	$419.00
Quattro Pro	$269.00
Sideways 3.2	$42.00
The Baler	$359.00

UTILITIES

1 Dir Plus 3.0	$49.00
386 To The Max Pro	$79.00
Above Disk 3.1	$65.00
Automenu	$39.00
Brooklyn Bridge 3.0	$75.00
Check It	$89.00
Copy II PC 5.0	$25.00
Copywrite/Zerodisk w/Rescue	$55.00
Direct Access	$52.00
Disk Technician Advanced	$99.00
Fastback Plus	$109.00
Headroom	$79.00
Lap Link Release III	$92.00
Magellan	$139.00
Norton Commander	$79.00
Norton Utilities Advanced	$79.00
PC Tools Deluxe 5.5	$77.00
Pop Drop Plus	$59.00
Print Cache (Lasertorq)	$99.00
Print Q 4.0	$89.00
Q-Dos II	$39.00
Software Bridge 4.0	$85.00
Speedstor	$35.00
Spinrite II	$69.00
Super PC-Kwik Powerpak	$79.00
XTree Pro Gold	$75.00

WINDOWS

Adobe Illustrator Windows	$295.00
AMI Professional	$319.00
Corel Draw Windows 1.1	$329.00
Crosstalk For Windows	$125.00
DB Fast/Windows	$169.00
Excel	$319.00
hDC Windows Express	$45.00
Hyperpad 1.0	$89.00
IBM Current	$295.00
Micrografx Designer	$469.00
Pagemaker 3.0	$529.00
Pubtech File Organizer	$159.00
Superbase 4 for Windows	$439.00
Word for Windows	$329.00

WORD PROCESSING

Displaywrite IV	$255.00
Grammatik IV	$52.00
Multimate 4.0	$295.00
Rightwriter	$52.00
Word 5.0	$219.00
Word Perfect 5.1	$249.00
Wordstar 5.5	$185.00

XENIX/UNIX

SCO Foxbase + 386	$675.00
SCO Unix Dev. System 386	$675.00
SCO Unix Operating System 386	$605.00
SCO Xenix Complete System 386	$1,079.00
Wordperfect for SCO Xenix 386	$519.00

Digitalk's Smalltalk/V PM combines the power of the industry's leading object-oriented programming with the richness of OS/2 Presentation Manager. Fully compiled, giving a PM application developer an extremely responsive environment. Contains a manual which is consistently reviewed as the best introduction to object-oriented programming available. Source code compatibility with Digitalk's other Smalltalk products.

Smalltalk/V PM $295.00

HiJaak is a graphics capture/conversion utility. Capture provides screen and LaserJet capture capability. Most popular screens are supported for graphics and text screen capture. Convert provides image interchangeability between various graphics file formats. HiJaak brings images into DTP packages from many sources. HiJaak also supports 13 Group-3-Fax cards.

HiJaak $95.00

INTERNATIONAL ORDERS 818 . 347 . 2444

FAX YOUR ORDER 818 . 347 . 9977

PHONE YOUR ORDER 800 . 733 . 3888

Immediate shipment on purchase orders from government and state agencies, cities, counties, school and universities. • Prices subject to change with out notice and while stocks last. • We ship the latest versions. • We accept Visa, Master Card, and American Express. • 2% surcharge on American Express. • 15% restocking fee for all non-defective items returned. • Please call (818) 347-9400 for an authorization number on defective goods or your return will not be accepted. • Due to copyright laws we cannot take back any software where the seal has been broken. • $5.50 minimum shipping per item, less on bulk orders. • $10 Blue Label shipping. • $4.50 C.O.D. charge. • Heavier items are charged accordingly. • We do not guarantee compatibility. • Call for prices for any software item not included in this ad. • Order desk open7 A.M. to 5 P.M. Monday to Friday (PST), Saturday 10 A.M. to 2 P.M.

P.O. Box 10598, Canoga Park CA 91309. Showroom: 7959 Deering Ave., Canoga Park California 91304.

WE WELCOME CORPORATE ACCOUNTS AND INTERNATIONAL ORDERS.

Circle 62 on Reader Service Card

WHO OWNS THE COPYRIGHTS?

All those involved in creating a computer program should make sure to determine their copyright interests

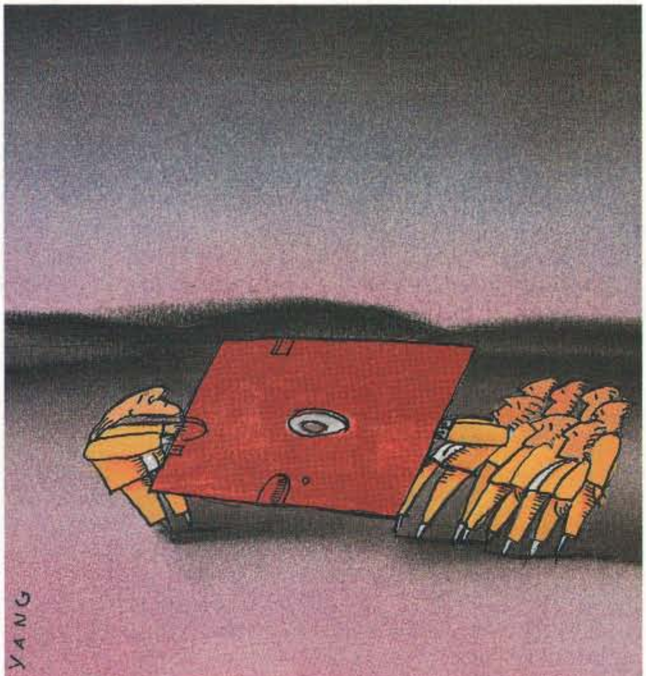
William T. McGrath

With the proliferation of computer usage in the business world, the importance of copyright ownership in computer programs can no longer be overlooked. A copyright owner obtains an array of valuable rights, including the exclusive right to sell copies of an original work and to sell new works based on or derived from the original work.

As a general rule, the author of a work is the owner of the copyright. However, if the author is an employee of a corporation or other business entity, and the work is created within the scope of employment, then the employer is the owner of the copyright.

More difficult questions arise if the author of the work is an independent contractor. In a typical situation, a company contracts with a freelance programmer to create software for a particular business application. The program is successful, and the company starts marketing the software commercially. The programmer also begins marketing the software or a modification of it.

Litigation is bound to follow—each party claiming that it has the exclusive right to sell the software. Much hangs in the balance, since the copyright owner not only can prevent the other party from selling the software but may also recover an award of damages, including any profits the infringer made from marketing the program.



The ownership question has been veiled in confusion for several years. The problem arose from conflicting interpretations given by courts to the "work-made-for-hire" rule of the Copyright Act.

Supreme Court Ruling

A recent decision by the U.S. Supreme Court, *Community for Creative Non-Violence* v. *Reid*, will eliminate much of the confusion. In the *Reid* case, involving ownership of a copyright to a sculpture, the Court for the first time addressed the issue of who owns the copyright to works created by independent contractors. The Court resolved the conflicting interpretations of the lower courts in a decision that greatly expands the rights of independent contractors.

For independent contractors, the decision is a boon. For hiring parties, the decision is a clear indication that certain contractual measures should be taken if the party wants to obtain ownership of a program's copyright.

The decision is a departure from the way the ownership issue has been analyzed in the past. It should cause computer professionals to reexamine the status of copyright ownership in the programs they have created or commissioned

continued

ILLUSTRATION: JAMES YANG © 1990

CATEGORIES OF WORK-MADE-FOR-HIRE

Works-made-for-hire by independent contractors must fall into one of these categories. In addition, there must also be a written agreement between the parties.

- Contribution to a collective work, such as a magazine or anthology*
- Audiovisual works
- Translations*
- Supplementary works, including work published as an adjunct to a work by another author*
- Compilations*
- Instructional texts
- Tests
- Answer material for tests
- Atlases

* These are the categories that, if broadly construed by the courts, a computer program could arguably fall into.

others to create. As a result of the Supreme Court's ruling, freelance programmers may own the copyrights to past works without realizing it.

The work-made-for-hire doctrine has two parts. The first part says that if a work is created by an employee within the scope of his or her employment, then the copyright is automatically owned by the employer. No written agreement is required, and it does not matter what kind of work is involved. This aspect of the Copyright Act is fairly straightforward and easy to apply.

The second part deals with "specially ordered or commissioned works" and provides that the commissioning party owns the copyright if the work is a work-made-for-hire. The Act provides that a commissioned work can be a work-made-for-hire if there is a signed agreement to that effect and the work falls into one of nine specifically identified categories of works (see the table). If these requirements are met, the commissioning party owns the copyright.

This seemingly clear dichotomy between works by employees and works on commission became hopelessly clouded when some lower courts held that commissioned works could be works-made-for-hire even though there was no signed agreement. The courts reasoned that if the hiring party exercised "supervision and control," the creator of the work could be considered an employee even though he was by most standards an independent contractor.

Since the independent contractor was viewed as an employee, the courts said that the employer owned the copyright, regardless of the type of work or whether there was a signed agreement. Several court cases applied this analysis and ruled that computer programs were owned by the commissioning party. The courts gave little guidance as to the type or degree of supervision and control necessary to give copyright ownership to the hiring party rather than the creator.

The *Reid* case has entirely changed the analysis for determining copyright ownership. The Supreme Court has eliminated the fiction that an independent contractor can be considered an employee merely as a result of supervision by the hiring party.

The Court ruled that an independent contractor owns the copyright to any work he or she creates unless there is an express signed agreement that the work is for hire and the work falls into one of the nine categories specifically identified in the Copyright Act. If there is no written agreement or if the work is not one of the types mentioned in the Act, the independent contractor retains ownership of the copyright.

In *Reid*, the Court ruled that the artist was an independent contractor, not an employee. Since there was no written agreement and sculpture did not fall into one of the nine categories, the artist owned the copyright.

Who Is an "Employee?"

The Court ruled that the determination of whether a hired party is an employee or independent contractor should be made according to traditional principles of agency law.

Under common law agency principles, several factors distinguish independent contractors from employees. In order to determine which is which, courts look at the skill the job requires, who owns the instruments and tools used in the job, the location of the work, the duration of the relationship between the parties, whether the hiring party has the right to assign additional projects to the hired party, and the extent of the hired party's discretion over when and how long to work.

The courts take into consideration additional factors, such as the method of payment, the hired party's role in retaining and paying assistants, whether the work is part of the regular business of the hiring party, whether the hiring party is in business, the provision of employee benefits, and the tax treatment of the hired party. No one of these factors is determinative.

What Qualifies as Work-Made-for-Hire?

As previously noted, a work by an independent contractor can only become a work-made-for-hire if it falls into one of nine categories of works listed in the Copyright Act. These categories are an odd conglomeration of different types of works. They are the result of lobbying efforts and compromises made during the legislative process.

Computer programs are not specifically identified. However, some of the categories are arguably broad enough to encompass programs under some circumstances. The scope of these categories is unclear, and they are sure to become the next battlefield in litigation over copyright ownership.

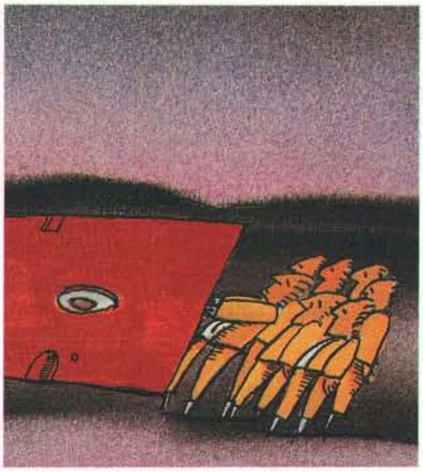
Courts have thus far provided no guidance as to whether they will be construed broadly or narrowly. If the courts interpret these categories broadly, a computer program could arguably fall into one of the following categories: contribution to a collective work, translations, supplementary works, and compilations.

• *Collective works*: A collective work is a work in which a number of contributions, constituting separate and independent works in themselves, are assembled into a collective whole. Typical collective works are periodicals, anthologies, and encyclopedias. It is not uncommon, however, for separate and independent software modules to be assembled into a collective whole. A recent court case involved a software system consisting of 236 separate programs. These independent modules could arguably be considered contributions to a collective work.

• *Translations*: Programmers often translate a program from a form written for one type of computer to a form suitable for another. A program can also be translated from one programming language to another. These arguably could be considered "translations" under the statute.

• *Supplementary works*: A supplementary work is a work prepared as a secondary adjunct to a work by another author for the purpose of illustrating, explaining, or assisting in the use of the other work. Examples are forewords, afterwords, pictorial illustrations, charts, tables, and indexes. In the computer indus-

It is not likely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire.



try, the user documentation and manuals accompanying the programs will often constitute supplementary works.

- *Compilations*: A compilation is a work formed by a collection of preexisting materials or data, arranged and selected so as to constitute an original work. Typical examples include telephone books, directories, and catalogs. But some computer programs could arguably be considered compilations, as in cases, for example, where subroutines from different programs are combined into a new program.

It is unlikely that Congress had the computer industry in mind when it adopted the nine categories of work-made-for-hire, and it remains to be seen how the courts will treat software in connection with these categories.

Joint Authorship of Computer Programs

Since the concept of "supervision and control" alone is not enough to create a work-made-for-hire, commissioning parties sometimes claim copyright ownership by virtue of being joint authors of the software.

The Copyright Act defines a joint work in true lawyer-like language as "a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole." To be a joint work, it is essential that at the time the work is created, the authors intend that their respective contributions will be merged into an integrated unit.

An author of a joint work is a co-owner of the work's copyright and is entitled to modify, reproduce, or distribute copies of the work. A joint author's protection extends to the entire work, not just the portion he or she contributed. Each author has the independent right to sell or license the joint work but has a duty to account to the co-owners for any profits earned.

Several cases have recently addressed the question of requirements to qualify as a joint author in the development of software. It is clear from these cases that a commissioning party who merely describes to the programmer what the software should do or look like is not a joint author.

In *Whelan* v. *Jaslow Dental Laboratory*, a case decided by the federal appeals court in Philadelphia, a dental laboratory owner commissioned the creation of software for use in his business. The owner gave the programmer a detailed description of the operation of the business, dictated the functions to be performed by the computer, and even helped design the language and format of some of the screens that would appear on the computer's visual displays.

The court nonetheless found that the programmer was the sole author of the software. The court's principal focus was on the creation of the source and object codes. The owner's general assistance and contributions to the fund of knowledge of the author did not make him a creator of any original work. The court made an analogy to an owner explaining to an architect the type and functions of a building the architect is to design. The owner is not a coauthor of the architectural drawings no matter how detailed the ideas or instructions he or she provides.

Obtaining Copyright by an Assignment

The Supreme Court's work-made-for-hire decision does not leave commissioning parties entirely out in the cold, however. A party can still obtain ownership of a copyright by a written agreement transferring the copyright. The ownership of the copyright simply becomes a matter of contract negotiation.

There are some pitfalls, though. To be valid, the transfer of copyright ownership must be in writing and signed by the copyright owner. Further, the Copyright Act provides that after 35 years, the copyright ownership will revert to the original author. While most software would be obsolete long before the reversion, it is conceivable that some systems could have a life that long.

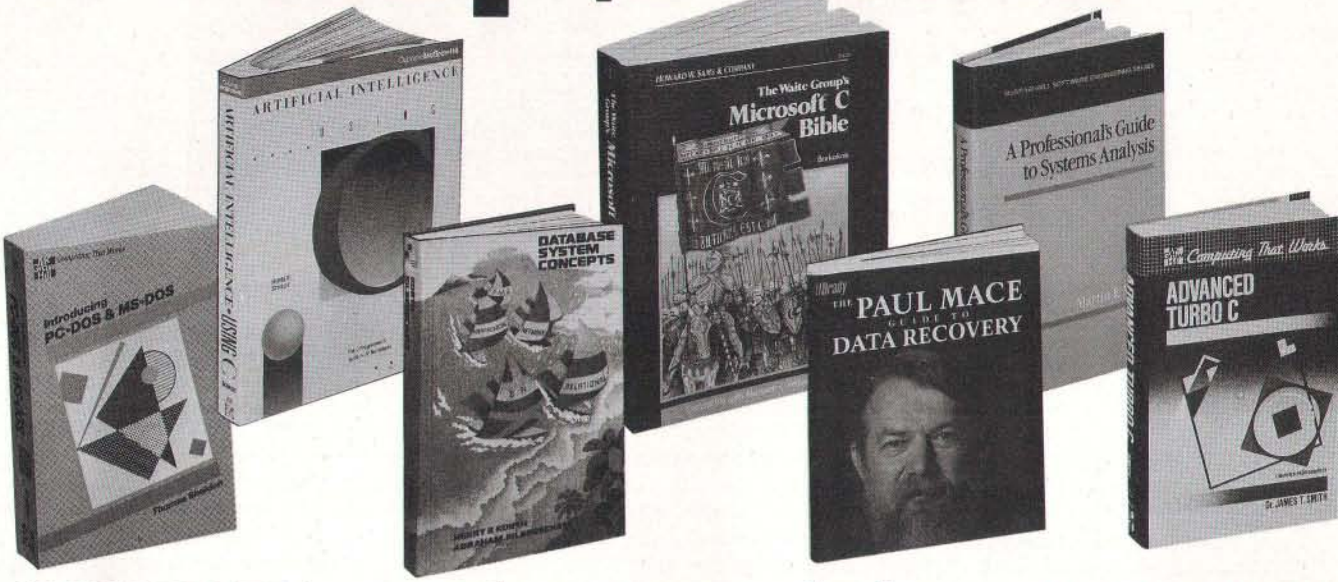
Copyright Importance to Programmers

The importance of copyright ownership cannot be overstated. The copyright owner controls reproduction, modification, and sale or licensing of a computer program. The financial benefits of ownership, too, are very real, especially where the software is unique or has high marketability.

The Supreme Court's decision resolves some issues, but it leaves many questions unanswered. Consequently, all parties involved in a computer program (even those programs that are already implemented) should exercise care in determining their copyright interest. As for future transactions, programmers should negotiate up front the matter of copyright ownership, and hiring parties should obtain a written assignment if they want to be sure they own the copyright to programs created by freelancers. ■

William T. McGrath is a partner at the law firm of Burke, Wilson, and McIlvaine Ltd., Chicago, Illinois. He practices primarily in the areas of copyrights, trademarks, and computer-related matters. He can be reached on BIX c/o "editors."

Take any 3 books for only $1.00 each



when you join BYTE Book Club®

VALUES UP TO $141.45!

- **Your one source for computer books from over 100 different publishers**
- **the latest and best information in your field**
- **discounts of up to 40% off publishers' list prices**

OS/2 PROGRAMMER'S GUIDE. *By* E. Iacobucci. *1100 pp., illus. softbound.* "Byte" magazine called it "a necessity." This giant reference explains all the basic functions you'll need, with emphasis on such new or different functions as multitasking and memory management.
881300-X Pub. Pr., $29.95

INTRODUCING PC-DOS & MS-DOS, Second Ed. *By* T. Sheldon. *403 pp., illus., softbound.* This Second Edition covers all releases through 4.0, as well as Microsoft Windows and DOSSHELL. Features the same hands-on tutorial format of the First Edition, with expanded coverage of batch file techniques that can dramatically increase your computing speed.
565/651 Pub. Pr., $27.95

LOCAL AREA NETWORKS: Architectures and Implementations. *By* J. Martin, *with* K. K. Chapman. *353 pp., illus.* An indispensable reference for all who buy, install, maintain, or manage LAN services. Provides complete coverage of the concepts, architectures, and implementations of LAN technology.
584900-3 Pub. Pr., $40.00

A PROFESSIONAL'S GUIDE TO SYSTEMS ANALYSIS. *By* M.E. Modell. *307 pp., illus.* Detailed coverage of what you need to know–what questions to ask, how to conduct a cost-benefit analysis, how to document and validate your findings–to design the best systems for your user's needs.
426/325 Pub. Pr., $34.95

ADVANCED GRAPHICS IN C: Programming and Techniques. *By* N. Johnson. *430 pp., illus., softbound.* Now C programmers can write crisp graphics programs for the IBM-PC using the IBM EGA (Enhanced Graphics Adaptor) or the AT&T Image Capture Board (ICB). Includes GRAPHIQ, a complete C graphics toolkit.
881257-7 Pub. Pr., $22.95

ADVANCED TURBO C. *By* J. T. Smith. *256 pp., illus., softcover.* Mastering Turbo C has never been easier. Crystal-clear answers to all your questions are supplemented by fully-documented programming examples. Coverage includes string processing, screen handling with *Turbo C Tools*, keyboard input, file handling, memory management, interrupt services, and much more.
587/078 Pub. Pr., $24.95

THE WAITE GROUP'S MICROSOFT C BIBLE. *By* N. Barkakati. *787 pp., illus., softbound.* The complete guide to all 370 functions, with purpose, syntax, example call, includes, common uses, returns, comments, cautions, and "see also" references for each function. Also features two handy tutorials on C basics and the C 5.1 compiler, as well as compatibility checks for all other C compilers.
584830-9 Pub. Pr., $24.95

THE PAUL MACE GUIDE TO DATA RECOVERY. *By* P. Mace. *352 pp., illus., softbound.* An indispensable guide to restoring vanished files and coping with virtually every type of data loss emergency. You get clear, step-by-step instructions for restoring deleted files or directories, recovering lost or damaged Lotus 1-2-3 files, what to do when your disk won't boot, and much, much more.
584926-7 Pub. Pr., $21.95

THE NEW DOS 4.0. *By* K. W. Christopher, Jr., B. A. Feigenbaum, *and* S. O. Saliga. *535 pp., illus., softbound.* Practical advice from IBM's own DOS 4.0 developers to help you harness more PC power and versatility. Covers SELECT, the DOS Command Prompt, batch filing, Command Line Redirection, the EDLIN Line Editor, and much more.
584889-9 Pub. Pr., $22.95

EGA/VGA: A Programmer's Reference Guide. *By* B.D. Kliewer. *269 pp., illus., softbound.* All the practical guidelines are right here for learning the ins and outs of the Enhanced Graphics Adaptor—one of the most popular PC add-on boards available—and its PS/2 counterpart, the Video Graphics Array. It's filled with innovative programming techniques . . . tips for working around the bugs in the BIOS . . . and EGA/VGA BIOS calls not available elsewhere.
350/892 Pub. Pr., $29.95

DATABASE SYSTEM CONCEPTS. *By* H. F. Korth and A. Silberschatz. *546 pp., illus.* From fundamental concepts to advanced problem solving, this book provides a clear understanding of the design and use of database systems. Also demonstrates the best ways to protect data from unauthorized access and malicious or accidental alteration or destruction.
447/527 Pub. Pr., $46.95

ARTIFICIAL INTELLIGENC USING C: The C Programmer' Guide to AI Techniques. *By* H Schildt. *412 pp., 37 illus., softbounc* This hands-on guide shows you ho to create your own AI applications an systems using C. After an introdu tory overview it provides coverage c expert systems, logic, natural lar guage processing, machine learning pattern recognition, and more, wit ready-to-run programs illustratin each topic.
881255-0 Pub. Pr., $21.9

PROGRAMMING USING THE LANGUAGE. *By* R.C. Hutchison an S.B. Just. *519 pp., illus.* Whether yo want to understand programs in written by others, or write better programs of your own, this practica authoritative book gives you the too and guidance you need. Coverag includes program organization, sor ing algorithms, recursion, linked list and more – with many sample pro grams.
315/418 Pub. Pr., $29.9

LIFE WITH UNIX: A Guide fo Everyone. *By* D. Libes *and* S. Re ssler. *346 pp., illus., softbound.* practical, readable sourcebook tha gives you the information you need use UNIX effectively. Provides a tho ough examination of its advantage and disadvantages . . . analyses fro the viewpoints of users, progran mers, and administrators . . . and complete guide to UNIX books, pe odicals, users' groups, and shar ware.
585017-6 Pub. Pr., $29.9

SECURITY IN COMPUTING. *By* C. Pfleeger. *538 pp., illus.* Here are th best ways to maintain the co fidentiality and integrity of your con puter system. This insightful guid helps you evaluate the security ris inherent in the computer tasks y perform and shows you exactly wh you must do to make your operatio secure.
584941-0 Pub. Pr., $44.0

PROGRAMMING WITH TURBO PASCAL. *By* D. Carroll.
852908-5 Pub. Pr., $39.95

HIGH-SPEED ANIMATION & SIMULATION FOR MICROCOMPUTERS. *By* L. Adams.
583855-9 Pub. Pr., $20.95

TURBO LANGUAGE ESSENTIALS: A Programmer's Reference. *By* K. Weiskamp, N. Shammas, *and* R. Pronk.
584905-4 Pub. Pr., $24.95

HARD DISK MANAGEMENT WITH MS-DOS AND PC-DOS. *By* D. Gookin *and* A. Townsend.
583954-7 Pub. Pr., $28.95

UNDERSTANDING & USING dBASE III® PLUS. *By* R. Krumm.
583940-7 Pub. Pr., $22.95

32-BIT MICROPROCESSORS. *Edited by* H. J. Mitchell.
425/85X Pub. Pr., $48.50

ADVANCED 80386 PROGRAMMING TECHNIQUES. *By* J. L. Turley.
881342-5 Pub. Pr., $22.95

NETWORKING SOFTWARE. *By* C. B. Ungaro.
606969-9 Pub. Pr., $39.95

THE DATABASE EXPERT'S GUIDE TO SQL. *By* F. Lusardi.
390/029 Pub. Pr., $24.95

PRINCIPLES OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS DEVELOPMENT. *By* D.W. Rolston.
536/147 Pub. Pr., $44.95

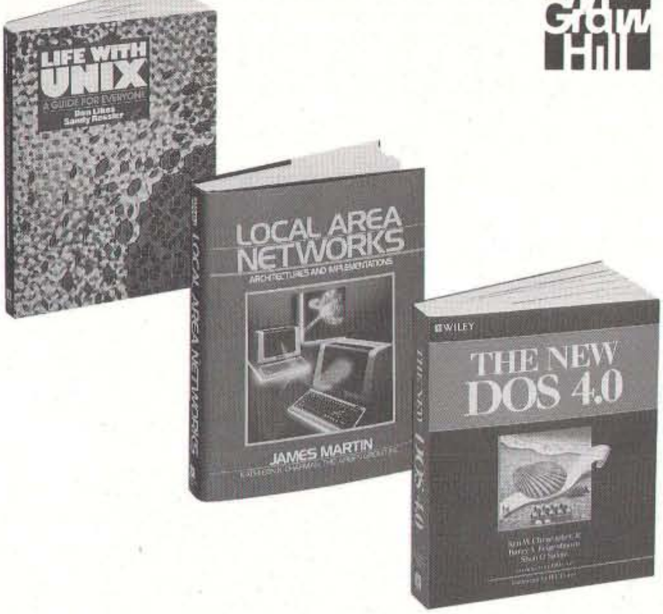
APPLYING TURBO PASCAL LIBRARY UNITS. *By* N. Shammas.
584791-4 Pub. Pr., $22.95

DATA STRUCTURES USING PASCAL, 2nd Ed. *By* A. M. Tenenbaum & M. J. Augenstein.
583738-2 Pub. Pr., $46.00

MICROCOMPUTER LANS: Network Design and Implementation. *By* M.F. Hordeski.
584580-6 Pub. Pr., $32.95

OPERATING SYSTEMS. *By* M. Milenkovic.
419/205 Pub. Pr., $44.95

IBM PS/2: A Reference Guide. *By* TJ Byers.
095/272 Pub. Pr., $39.95



Any 3 books for $1.00 each... if you join now and agree to purchase two more books—at handsome discounts—during your first year of membership.

MASTERING TURBO PASCAL 4.0, 2nd. Ed. *By* T. Swan.
584762-0 Pub. Pr., $22.95

DESIGNING USER INTERFACES FOR SOFTWARE. *By* J.S. Dumas.
584641-1 Pub. Pr., $31.00

68000 ASSEMBLY LANGUAGE PROGRAMMING, 2nd Ed. *By* L. Leventhal; D. Hawkins; G. Kane & W. Cramer.
583817-6 Pub. Pr., $28.95

C CHEST AND OTHER C TREASURES FROM DR. DOBB'S JOURNAL. *Edited by* A. Holub.
584807-4 Pub. Pr., $24.95

CICS FOR MICROCOMPUTERS. *By* J. L. LeBert.
369/682 Pub. Pr., $29.95

FILE ORGANIZATION FOR DATABASE DESIGN. *By* G. Wiederhold.
701/334 Pub. Pr., $44.95

STRETCHING TURBO C. *By* K. Porter.
584967-4 Pub. Pr., $24.95

1-2-3 RELEASE 3: The Complete Reference. *By* M. Campbell.
881318-2 Pub. Pr., $28.95

PROGRAMMING IN C, Revised Ed. *By* S.G. Kochan.
584701-9 Pub. Pr., $24.95

MASTERING ORACLE: Featuring Oracle's SQL Standard. *By* D. J. Cronin.
585034-6 Pub. Pr., $24.95

STRUCTURED PROGRAMMING IN ASSEMBLY LANGUAGE FOR THE IBM PC. *By* W. C. Runnion.
584827-9 Pub. Pr., $43.25

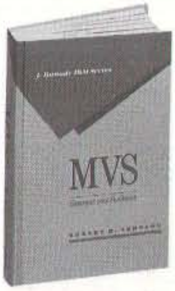
PORTABILITY AND THE C LANGUAGE. *By* R. Jaeschke.
584966-6 Pub. Pr., $34.95

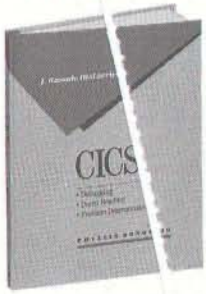
DATA TYPES AND DATA STRUCTURES. *By* J. J. Martin.
583689-0 Pub. Pr., $45.00

WORDPERFECT®: THE COMPLETE REFERENCE. *By* K. Acerson.
881312-3 Pub. Pr., $27.95

TROUBLESHOOTING AND REPAIRING THE NEW PERSONAL COMPUTERS. *By* A. Margolis.
583871-0 Pub. Pr., $18.95

New! BYTE LARGE SYSTEMS Books





MVS: Concepts and Facilities. *By* R. H. Johnson. *613 pp., illus.* This comprehensive overview of IBM's mainframe operating system provides you with a crucial edge in MVS programming, management, and systems development. Covers processor complexes, MVS/XA and MVS/ESA, DASDs, the I/O subsystem, and much more.
326/738 Pub. Pr., $39.95

CICS: Debugging, Dump Reading, Problem Determination. *By* P. Donofrio. *176 pp., illus.* A long-needed, step-by-step troubleshooting guide for CICS programmers. Provides invaluable information on problem determination, interactive debugging, terminal autoinstall, service strategies, the new dump formatting routine, and dump reading procedures that will have you clearing up failures in no time.
176/06X Pub. Pr., $ 9.95

Here's how BYTE Book Club® works to serve you:

- **Important information . . . we make it easy to get!** Today, professionals who perform best are those who are best informed. For reliable, hands-on information, turn to the Byte Book Club. Every 3 or 4 weeks (12-15 times a year), members receive the Club Bulletin offering more than 30 books – the best, newest, most important books from *all* publishers.
- **Dependable service . . . we're here to help!** Whether you want information about a book or have a question about your membership, just call us *toll-free* or drop us a line. To get only the books you want, make your choice on the Reply Card and return it by the date specified. If you want the Main Selection, do nothing – it will be sent to you automatically. (A small shipping and handling charge is added to each shipment.)
- **Club convenience . . . we do the work!** You get a wide choice of books that simply cannot be matched by *any* bookstore. And all your books are conveniently delivered right to your door. You also get 10 full days to decide whether you want the Main Selection. (If the Club Bulletin ever comes late and you receive a Main Selection you don't want, return it for credit at *our expense.)*
- **Substantial savings . . . and a bonus program too!** You enjoy substantial discounts–up to 40%!–on every book you buy. Plus, you're automatically eligible for our Bonus Book Plan which allows you *savings up to 70%* on a wide selection of books.
- **Easy membership terms . . . it's worthwhile to belong!** Your only obligation is to purchase 2 more books – at handsome discounts – during the next 12 months, after which you enjoy the benefits of membership with no further obligation. You or the Club may cancel membership anytime thereafter.

Fill out the card and mail today! If the card is missing, write to:

BYTE Book Club,® P.O. Box 582, Hightstown, New Jersey 08520-9959
For faster service in enrolling, call 1-800-2-MCGRAW

BYCA-024

Now There's a Periscope Board for Your IBM PS/2®

With the new Periscope® Model I/MC, you now have the same robust Periscope Model I debugging capabilities using a PS/2 with Micro Channel® architecture that you already have using a PC, XT, AT, or AT-compatible 80386 machine.

Just like the current Periscope Model I, Periscope Model I/MC has a 32K footprint in system memory, above 640K but in the first megabyte. The board stores the Periscope software and all debugging information (symbols, etc.) in its write-protected RAM.

Designed for use in machines with the IBM Micro Channel bus architecture, the board allows you to add chips to extend the 512K of write-protected RAM to a full two megabytes, if need be. (Most developers find 512K to be quite enough, however.)

Real-time hardware-assisted debugging of programs running on PS/2s is now possible! The remote feature of the new Version 4.3 Periscope software enables Periscope IV to support real-time debugging of programs running on DOS-based machines, including those with Micro Channel architecture. The open architecture remote debugging feature will support OS/2® and other protected-mode environments in the near future. Call for details.

Don't worry about trashing your debugger, debugging large programs, or erratic bugs.

With this new board in your IBM PS/2 or compatible, Periscope uses zero memory in the lower 640K. So you don't have to worry about things like a runaway program trashing your debugger, or not being able to debug a very large program, or having bugs appear or disappear when you load your debugger.

Use the break-out switch, which plugs into the board, to break in to your system safely any time. It keeps you from having to power down and back up when your system hangs. You can just press the little red "panic" button to find out exactly what is going on.

Choose from a full line of professional software and hardware-assisted models.

All models include Version 4.3 software, manual, and:

- *New* **Periscope I/MC** (MC Board for short) has 512K Micro Channel-compatible board & break-out switch .... $745.
- **Periscope I** has 512K PC- and AT-compatible board & break-out switch ..... $595.
- **Periscope II** has break-out switch .... $175.
- **Periscope II-X** has no hardware ...... $145.
- **Periscope III** has PC- and AT-compatible real-time board (to 10MHz) & break-out switch .... $1395.
- **Periscope IV** has 80286 and 80386 AT-compatible real-time hardware (to 25MHz) & breakout switch .... $2195-$2995.
- **PLUS** board is Model I board (no software), optional with Models III & IV ....$500.

Periscope Model I for PCs, XTs, ATs, and AT-compatible 80386s. The manual, disk, and quick-reference card shown come with all models of Periscope.

Circle 219 on Reader Service Card
(DEALERS: 220)

TECHNICAL EXCELLENCE PC MAGAZINE FINALIST
ADD-IN BOARDS THE PERISCOPE COMPANY, INC. PERISCOPE III 1988

Call Toll-Free Today For More Information 800-722-7006

MAJOR CREDIT CARDS AND QUALIFIED COMPANY PURCHASE ORDERS ACCEPTED

IBM, PS/2, OS/2, and Micro Channel are registered trademarks of the IBM Corporation.

1197 PEACHTREE ST. • PLAZA LEVEL • ATLANTA, GA 30361
404/875-8080 FAX 404-872-1973

The Periscope Company, Inc.

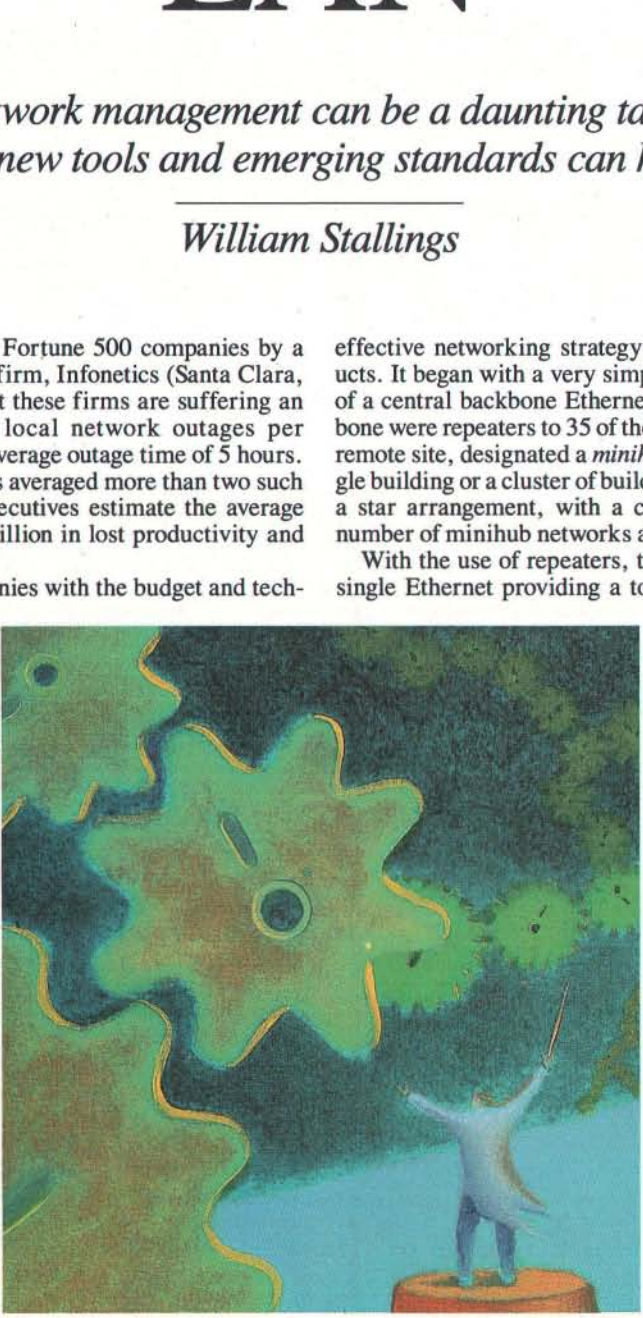
MANAGING THE WELL-TEMPERED LAN

Network management can be a daunting task, but new tools and emerging standards can help

William Stallings

A recent survey of Fortune 500 companies by a market research firm, Infonetics (Santa Clara, CA) revealed that these firms are suffering an average of two local network outages per month, with an average outage time of 5 hours. About 5 percent of the companies averaged more than two such outages per week. Company executives estimate the average annual costs per firm at $3.5 million in lost productivity and over $600,000 in lost revenue.

These are Fortune 500 companies with the budget and technical staff to handle local network installations, so how can this be? The answer is their lack of effective network management. Networks have grown in many ways—physical extent, number of users, amount and diversity of traffic, and complexity of supporting communications software. In addition, in too many companies, network management tools and procedures have not kept pace with these factors.



One University's Experience

LAN administrators who follow the industry's product offerings are aware that software tools can help to keep a LAN or set of LANs running smoothly. For example, a large university (which, for security reasons, will remain nameless) has developed an effective networking strategy based solely on Ethernet products. It began with a very simple architecture based on the use of a central backbone Ethernet. Attached to this central backbone were repeaters to 35 of the 110 on-campus buildings. Each remote site, designated a *minihub*, serviced equipment in a single building or a cluster of buildings. Thus, the architecture was a star arrangement, with a central backbone network and a number of minihub networks attached to the backbone.

With the use of repeaters, the entire system functioned as a single Ethernet providing a total capacity of 10 megabits per second. With growth in the number of users and in the amount of time average users utilize the network, however, this capacity soon became insufficient.

As the load on the network increased, the university was able to keep pace by splitting the backbone into two backbones connected by an Ethernet bridge. Effective use of this configuration requires thoughtful load balancing to minimize the traffic through the bridge and avoid a bottleneck. With the aid of a traffic-monitoring package, the university was able to observe the traffic between pairs of stations and make an effective split.

At present, this architecture is sufficient to serve the needs of the main campus. However, there are also five

continued

ILLUSTRATION: PAUL COZZOLINO © 1990

regional campuses located in a 90-mile radius around the main campus. Each of these sites requires a network for on-campus communications, as well as links to the other regional campuses and the main campus. In keeping with their main-campus configuration, the university has developed an architecture that is simple, uniform, and compatible with the central campus architecture and that provides communications both within each

Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture.

regional campus and among all the campuses.

Each regional campus is served by a minihub. Each minihub is connected to the main campus by means of a pair of remote bridges. At installation, each pair of remote bridges is connected by a 56,000-bps link provided by a university-owned private microwave system.

For emergency backup, an alternative path via 9600-bps modems using dial-up telephone lines is in place. Thus, if the microwave system fails, by using the public telephone network, the university still has a limited amount of connectivity. If the single 56,000-bps link becomes saturated, it is possible to install an additional 56,000-bps link between the same two bridges. The bridges use multiple links simultaneously, load-balancing between them automatically.

This scheme extends the transparent, seamless interconnection of devices to the regional campuses. In effect, the regional networks and the central system perform as a single Ethernet.

Every station on the expanded network has a unique address, and any station can address any other station with no knowledge of its physical location. The consistent use of repeaters and bridges guarantees this transparency. Furthermore, the regional campuses are poised for expansion with no disruption or reconfiguration of the overall network. Any regional minihub linked to the central network can become the central segment in a starlike expansion using repeaters and Ethernet segments, replicating the central campus architecture. Indeed, any of the regional campuses can establish a two-segment backbone in the same manner as the central campus. The same seamless interconnection exists no matter how much the remote network expands.

Automated Tools Help

The network management group uses several software control tools. These tools support the institution's ability to configure devices remotely, to diagnose problems, and to reboot terminal servers. The university uses utilities for automating password changes, collecting server usage statistics, and reviewing server-PROM revision levels.

The university also uses network management software to produce audit trails for all connections, disconnections, occurrences of queues, network faults, and other network events of significance. The audit trail helps determine future needs for additional host computer connections, identify common client mistakes, and study other usage trends.

Also obtainable is a LAN-monitoring package that provides cumulative information on overall Ethernet traffic. Reports, available in real time, supply information regarding peak throughput and long-term utilization trends. The information helps determine expansion requirements, assists in deciding how to load-balance the two halves of the core network, and generally provides a good picture of overall use and performance of the Ethernet.

The software is deficient in one area, however: fault isolation. Initially, the university mixed Ethernet components from two different vendors. Each of these products had strong points. However, this mix created chronic problems. Each manufacturer, of course, credited the other manufacturer's equipment as the source of the intermittent (but severe) network disruptions. Finally, for the sake of standardization, the university eliminated all LAN equipment except that of a single vendor. The improvement in network reliability was dramatic.

Prior to the standardization, there was an average of three user-perceivable Ethernet disruptions per day. After standardization, the rate settled down to fewer than one disruption per month. This improvement resulted not because the remaining vendor was the only reliable one, but because there was a single point of responsibility for errors.

Configuration Assistance Welcome

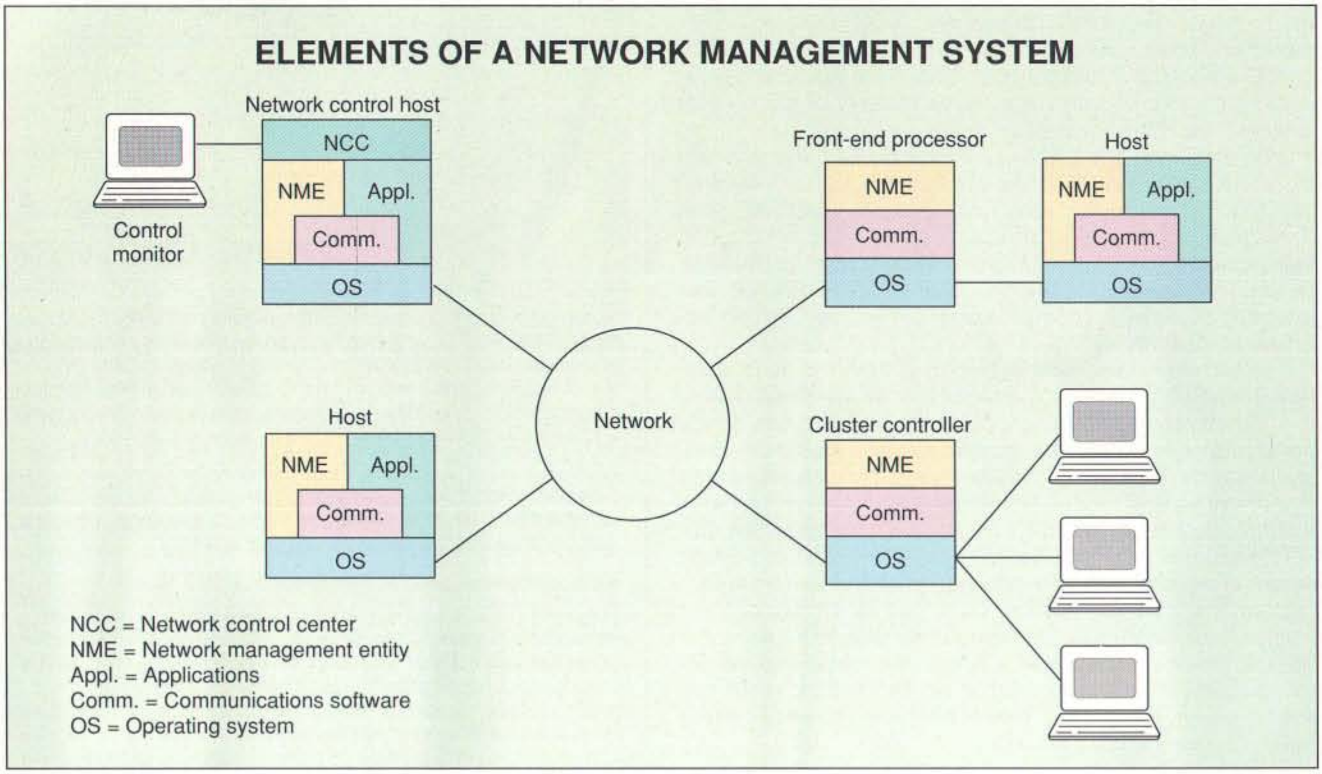
As another example, consider the difficulties of a government research center that was relying on a broadband LAN to tie together mainframes, minicomputers, personal computers, and terminals located in over 100 buildings spread across a 350-acre site. As the traffic on the LAN grew, it became impossible to accommodate all the equipment on a single 5-Mbps, 6-MHz channel. As a result, the center opened up five channels on the LAN with channel-to-channel bridges to allow any device to talk to any other device.

The center tried to cluster groups of users on the same channel, but, even so, users occasionally reported slow responses. Also, there were instances when connections seemed to lock up and require cancellation. To manage the network properly and plan for growth, the center installed performance-monitoring software that provided a profile of connections across bridges versus connections on the same channel, traffic per connection, traffic per bridge, and other useful statistics. Thus, the center was able to continually adjust channel assignments to maintain proper load balancing.

This software, however, was insufficient to diagnose a new problem that cropped up. At random times, a surge of traffic would drastically reduce response time. This situation would occur without any noticeable change in the number of connections or active users. The center decided to add software that could count the number of retransmissions of packets by source and by channel. As a result of the installation, a clue emerged. The slow response time coincided with high retransmissions on two particular channels involving a terminal cluster on one channel and a large minicomputer on the other.

The monitoring software was set to generate an alarm when this condition occurred. When the alarm sounded, a network administrator checked the jobs running on the minicomputer and eventually traced the problem to a high-volume graphics job that would dump large volumes of data onto the LAN. After

continued



Each system includes a network management entity package that performs local functions. It can communicate with a network control center that has the same software as other nodes, plus network control software that provides a user interface for managing the entire network.

this diagnosis, it was possible to reconfigure the network to solve the problem.

The use of monitoring software to diagnose and resolve performance problems is perhaps an obvious tactic that most LAN customers will employ. There are other areas that may seem more mundane but that nevertheless can save much time and energy. Any software that will help in the configuration process becomes valuable when an organization grows from a small user population on one LAN to a large population on a number of LANs spread throughout several sites.

Network Management Systems

Most personnel responsible for network management appreciate the value of network management software. But two problems confront the manager. First, the variety of tools needed can lead to the procurement and use of a number of packages with different user interfaces and different hardware platform requirements. Second, if the facility includes equipment from a number of vendors, it is difficult to find software that works effectively across all vendor brands.

From the user's point of view, the best approach would be to obtain a set of tools for network management that provides several features. It would contain a single-operator interface with a powerful but user-friendly set of commands for performing most or all network management tasks. It would require a minimal amount of separate equipment. That is, most of the hardware and software required for network management would be incorporated into the existing user equipment.

A system that supplies this type of integration is generally referred to as a network management system. It consists of incremental hardware and software additions implemented among existing network components. The software used in accomplishing the network management tasks resides in the host computers and communications processors (e.g., front-end processors and network interface units). A network management system is designed to view the entire network as a unified architecture, with addresses and labels assigned to each point and the specific attributes of each element and link known to the system. The active elements of the network provide regular feedback of status information to the network control center.

The figure illustrates the architecture of a generic network management system. Each network node contains a collection of software devoted to the network management task, referred to in the diagram as a network management entity. Each NME collects statistics on communications and network-related activities and stores statistics locally. Each NME also responds to commands from the network control center, including those that transmit collected statistics to the network control center, change a parameter (e.g., a timer used in a transport protocol), provide status information (e.g., parameter values and active links), and generate artificial traffic to perform a test.

At least one host in the network is designated as the network control host. In addition to the NME software, the network control host includes a collection of software called the network control center. The NCC includes an operator interface to allow an authorized user to manage the network. The NCC responds to user commands by displaying information and/or by issuing commands to NMEs throughout the network. This communication is carried out using an application-level network management protocol that uses the communications architecture in the same way as any other distributed application.

continued

The Book is dead. Long live the CD-ROM.

An exaggeration? Remember what the automobile did to horse drawn carriages. OK, books aren't buggy whips, but CD-ROM will forever change the way we store, distribute and access information.

CD-ROM NEWS

You've probably read a lot about this exciting technology recently. At Compact Disk Products we were early believers in the benefits of CD-ROM and formed an entire company to promote its use. Look to this column each month for CD-ROM news and new product information. Then look for our special offers of the most popular CD-ROM hardware and software. This month we've joined with two CD-ROM industry heavyweights, Microsoft and Hitachi, to offer packages that will convince you to join the information revolution now.

HITACHI CDR-3600 EXTERNAL AVAILABLE

Since its September,1989 debut, the third generation CDR-3600 has become the leading internal CD-ROM drive. Many owners of earlier drives are upgrading to the CDR-3600 with its look ahead cache, linear pickup head motor and compact design. Now CDP is pleased to offer the CDR-3600's superior speed and reliability to users who need an external model (available for either domestic or international voltages).

Dealer Inquiries Welcome

photo: Doug Kilpatrick

CDP SPECIAL OFFERS

PACKAGE A - $899 ($1290 value)

Microsoft Bookshelf and HITACHI CDR-3600 INTERNAL drive kit (complete)! Make your writing more precise and more interesting with this indispensable collection of references. Includes *The World Almanac and Book of Facts, Chicago Manual of Style, Bartlett's Familiar Quotations, Roget's II: Electronic Thesaurus, American Heritage Dictionary, Forms and Letters.* RAM resident. Search a complete reference work from within your document. Powerful cut and paste features for use with popular word processing and spreadsheet programs.

PACKAGE B - $999 ($1390 value)

Microsoft Programmer's Library and HITACHI CDR-3600-INTERNAL drive kit (complete)! "*...a masterpiece of simplicity and function.*" -PC World, May, '89. The most comprehensive, authoritative and valuable collection of programming documentation available. Instant access to Microsoft's Technical Reference Manuals and Microsoft Press books for OS/2, Windows, C, FORTRAN, MASM and more. Over 3,000 files of source code.

OTHER PACKAGES AVAILABLE

BONUS OFFER: Until April 30, order package A or B and buy any of the following for only $49 each.

- **CD-PLAY:** Give your CD-ROM drive more features than top-of-the-line home audio CD-Players. Ram resident.
- **Food Analyst CD-ROM:** The complete nutritional analysis software.
- **Programmer's ROM:** Useful source code in Pascal, Assembler, Modula 2, OS/2 and 8 other languages.
- **Sherlock Holmes on Disk:** The complete unabridged works with graphic woodcuts.

Compact Disk Products

Compact Disk Products
223 East 85th Street
New York, NY 10028

Inquiries (212) 737-8400
Fax (212) 737-8289
Compuserve 75530,214

ORDERS
(800)-MEGABYTe (634-2298)

UNCONDITIONAL GUARANTEE

If for ANY REASON you are unhappy with your purchase, return it within 30 days for a FULL REFUND of your purchase price (not shipping and handling).

DIVISIONS OF NETWORK MANAGEMENT

Table 1: ISO is developing standards for network management within a framework consisting of five main functional areas.

Fault management	The facilities that enable the detection, isolation, and correction of abnormal operation of the OSI environment.
Accounting management	The facilities that enable charges to be established for the use of managed objects and costs to be identified for the use of those managed objects.
Configuration and name management	The facilities that exercise management control over, identify, collect data from, and provide data to managed objects. They assist in providing for continuous operation of interconnection services.
Performance management	The facilities needed to evaluate the behavior of managed objects and the effectiveness of communications activities.
Security management	The facilities that address those aspects of OSI security essential to operate OSI network management correctly and to protect managed objects.

NETWORK MANAGEMENT STANDARDS

Table 2: So far, ISO has issued five standards that relate to network management. The overall management framework is part of the OSI model specification.

ISO 7498-2	Open Systems Interconnection—Basic Reference Model Part 4: Management Framework
DIS 9595	Common Management Information Service (CMIS) definition
DIS 9596	Common Management Information Protocol (CMIP) specification
DP 10040	Systems Management Overview
DP 10164	Structure of Management Information

Several observations are in order. Since the network management software relies on both the host operating system and the communications architecture, most offerings to date are designed for use on a single vendor's equipment. In the case of a network of personal computers, there are a number of LAN network management packages that will tie together personal computers from a number of vendors. Standards in this area are still immature, but in the next few years, there should emerge standardized network management systems designed to manage a multiple-vendor network.

As depicted in the figure, the NCC communicates with and controls what are essentially software monitors in other systems. The architecture can be extended to include technical control hardware and specialized performance-monitoring hardware as well.

To maintain high availability of the network management function, it makes sense to use two or more NCCs. In normal operation, one of the centers idles or simply collects statistics while the other performs control functions. If the primary NCC fails, the backup system should still function.

Network Management Standards

As LANs for personal computers expand to become networks of LANs, the need for network management becomes increasingly important. Until now, LAN users have had to rely on a simple network control facility provided by the LAN hardware vendor, or a set of proprietary software, such as IBM's NetView or the Novell software. These approaches will ultimately be inadequate for several reasons.

Users want the freedom to mix equipment from different vendors and yet retain a unified network management architecture with a single interface. Also, tools developed to deal with single-LAN management are inadequate for dealing with an internet consisting of multiple LANs and wide-area networks.

What is needed is a standard for network management that would function as the basis for multivendor and multinetwork management tools. The International Standards Organization (ISO) has developed a standard for network management referred to as the Open Systems Interconnection (OSI) management framework. It specifies the functions to be performed by a network management system and defines protocols for the exchange of commands, responses, and measurement data.

This standard is relatively new, and no products are yet available. However, it is serving as the basis for network management systems being developed by computer and LAN vendors and, as such, will assume increasing importance in the marketplace.

Functional Areas

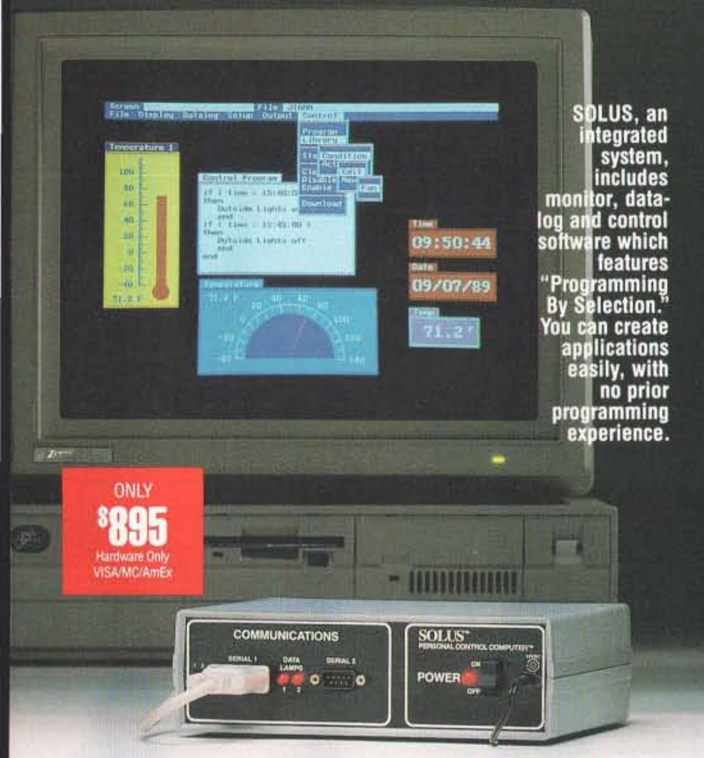
The ISO document divides the network management task into five functional areas (see table 1). These areas provide a useful checklist for assessing any network management offering.

Fault management facilities allow network managers to detect problems in the communications network and the OSI environment. These facilities include mechanisms for the detection, isolation, and correction of abnormal operation in any network component or any of the OSI layers.

Fault management facilities detect and report the occurrence of faults. These procedures allow a managed system to notify its manager of the detection of a fault, using a standardized event-reporting protocol. Other facilities log the received event report. This log can then be examined and processed. In addition, there are fault management procedures that schedule and execute diagnostic tests, trace faults, and initiate correction of faults. These procedures can be invoked as a result of analyzing the event log.

Accounting management facilities allow a network manager to determine and allocate costs and charges for the use of network resources. They provide procedures that inform users of costs incurred, using event reporting and data manipulation software, and enable accounting limits to be set for the use of managed resources. They also enable costs to be combined where multiple resources are used to achieve needed communication.

continued



Configuration and name management facilities allow network managers to exercise control over the configuration of the network components and OSI layer entities. Configurations can be changed to alleviate congestion, isolate faults, or meet changing user needs. Configuration management provides procedures to collect and disseminate data concerning the current state of resources. Locally initiated changes or changes due to unpredicted occurrences are communicated to management facilities by means of standardized protocols.

These facilities also provide procedures that set and modify parameters related to network components and OSI layer software, as well as initialize and close down managed objects. They also change the configuration and associate names with objects and sets of objects.

Performance management facilities enable the network manager to monitor and evaluate the performance of network and layer entities. Performance management provides procedures to collect and disseminate data concerning the current level of performance of resources, and maintain and examine performance logs for purposes such as planning and analysis.

Security management facilities allow a network manager to manage those services that provide access protection for communications resources. Security management provides support for the management of authorization facilities, access control, encryption and key management, authentication, and security logs.

OSI Management Architecture

The key elements of the architectural model of an OSI system are as follows:

- *Network management application.* This application provides the mechanism for the network manager, a human, to read or alter data, control the network, and access reports. Residing in the NCC, this application could be a very simple command interpreter or an expert system requiring very little interaction with the network manager.
- *System management application process (SMAP).* This application is the local software within a system responsible for executing the network management functions on a single system (e.g., host and front-end processor). It has access to an overall view of system parameters and capabilities and can, therefore, manage all aspects of the system and coordinate with the network management application and SMAPs on other systems.
- *System management application entity (SMAE).* This application is responsible for communication with other nodes, especially with the network management application in the NCC host. Standardized application-level protocols are used for this purpose.
- *Layer management entity (LME).* Software is embedded into each layer of the OSI architecture to provide network management functions specific to that layer.
- *Management information base (MIB).* This is a collection of information at each node pertaining to network management.

By defining these five items, ISO has created a structure within which developers can create standards relating to network management.

Related ISO Standards

The OSI management framework document (ISO 7498-4) is part of the overall specification of the OSI architecture. It supplies a general structure for network management. In addition, ISO is developing specific standards for various aspects of network management (see table 2).

These ISO standards are important to the user who is planning a future network management strategy. Although the standards have not been finalized, several vendors are positioning themselves to provide ISO-compliant network management products. Furthermore, the products being developed will operate not only on the OSI architecture, as you would expect, but also on the TCP/IP protocol suite.

This latter communications architecture, developed as a set of military standards, is widely used in LAN products. Thus, whether your installation uses TCP/IP or OSI-based products, the ISO standards offer the means for developing a vendor-independent network management capability.

The ISO standards are based on three key concepts: the management information base (MIB), the Common Management Information Protocol (CMIP), and the Common Management Information Service (CMIS).

The MIB is a list of items that can be managed by the network management system. The network management specifications developed for TCP/IP make use of the same formats and include a subset of the objects defined in the ISO standard.

The CMIP is the protocol by which various management entities communicate. The use of the term *common* refers to the fact that the protocol is used to support work in all five functional areas of OSI network management (those listed in table 1). This application-level protocol is part of the OSI protocol suite and is intended to work with systems that implement the OSI architecture.

In the TCP/IP community, the current draft version of CMIP is used in CMOT (for CMIP over TCP/IP). This is the same protocol; the difference is that the protocol is specified to run over TCP/IP rather than the OSI protocols. A number of TCP/IP vendors are working on CMOT implementations. In the meantime, the TCP/IP community is relying on the Simple Network Management Protocol (SNMP), which provides a rudimentary network management capability that can be used in the near term. SNMP and CMOT share the same management information base, which will make migration easier.

Finally, the CMIS defines the services that can be supported by CMIP.

Network Management Solutions

The need for network management grows with the complexity and scale of the networks to be managed. Although it is possible to acquire software and hardware tools that address specific areas individually (e.g., fault detection and security), a full-fledged integrated network management system is the most effective way to satisfy the spectrum of network management requirements.

As in other aspects of computer communications, proprietary approaches to network management create difficulties in the areas of flexibility and vendor independence. Accordingly, the ISO network management framework and evolving standards offer hope for resolution of the network management problems facing those with substantial network installations. Both TCP/IP and OSI-based products that conform to this set of standards are beginning to appear. Now is the time to plan for the use of this effective network management system. ■

Editor's note: *This article is based on material in the author's new book,* Business Data Communications *(Macmillan, 1990).*

William Stallings is president of Comp-Comm Consulting in Prides Crossing, Massachusetts, and the author of 14 books on data communications and computer systems. He can be reached on BIX c/o "editors."

BIX CALENDAR APRIL

Display this month's BIX activities

A P L

Interactive Games Exchange offers two new conferences.

If you've ever felt you were in a time warp, join sca (Society for Creative Anachronisms) and swap stories with other people who know the feeling. Right now, SCA is exploring the medieval experiences of contemporary people.

And if you have children under age 14, introduce them to BIXing. It's fun for kids, encourages social interaction, and promotes computer literacy. (join bix.kids)

For other information about IGX, see below.

Exchange Updates

Real-time on the Interactive Games Exchange—The IGX continues to offer real-time fun — such as role-playing game techniques in the ff conference and on-line backgammon and trivia in the fun.n.games conference. If your idea of fun is a serious debate on social issues, you'll want to join the gazebo conference every Monday night. If you want to meet with BIX management and talk about whatever is on your mind, join the gazebo conference on Thursdays. For free-form role-playing games that take you back to the Middle Ages — and sometimes far into the future — check into the Meade & Mirth Inn every night at 9 PM EST. (join mnm/inn)

IBM Exchange—In concert with the April BYTE's focus on GUIs and 80386 motherboards, this month's IBM Exchange will feature discussions on both Microsoft Windows and OS/2 Presentation Manager GUIs. The topics will be explored from the perspectives of both the user and the programmer. We'll also discuss the ways in which other companies, such as Lattice and Borland (both of which have vendor conferences on BIX) support Windows and PM programming. (join microsoft and ibm.os2)

If you're considering replacing an 80386 motherboard, you'll want to join either the ibm.at or ibm.pc conference. We'll discuss what you should look out for when buying one, prices, speed/performance, compatibility with Unix and OS/2, and how to fit them into XT/AT cases. We'll even drop a few names of suppliers and their prices, and invite other conference attendees to describe their experiences with motherboard replacements.

Mac Exchange—This month, the Mac Exchange will provide coverage of the MacExpo in San Francisco, with several reports from the floor on what to see, what's hot, and what's on the way. If you plan to attend the show, we'll help you plan your time wisely. If you're not coming, the Mac Exchange promises to be the next best thing.

Other offerings in the Max Exchange during April include our continuing on-line C tutorial, product critiques, and question-and-answer sessions about every facet of the Macintosh world.

BIX Conference News The Oakland Group, makers of the C-scape object-oriented interface management system for DOS, Unix and Look&Feel (a screen design tool), has joined the BIX vendor Support Exchange. (join oakland.group)

Video Associates Labs (VAL) has opened a conference to support users of its Microkey Mark 10 video overlay (genlock) hardware. (join val)

Hot and cold fusion, interstellar travel, and electronic gadgets are some of the discussion topics in the new Technology Conference. (join technology)

The 7th Annual Contact Conference, where anthropologists, physicists, science-fiction writers, sociologists, and xenobiologists explore their common ground, was held during March in Phoenix, Arizona. BIXen prepared for this annual meeting and will continue its spirit of cooperation all year long in the Contact Conference. (join contact)

Circle 450 on Reader Service Card

Finally. An on-line service that doesn't nickel and dime you.

It's BIX's flat-fee service
BIX is short for BYTE Information Exchange. The on-line information service that's yours for an unheard-of flat fee of just $39 for three months*—an amount you could easily waste in just two to four hours with an *hourly rate,* on-line service. (Not to mention the fact that you'd be nickel-and-dimed for its monthly minimums.)

And here's another distinction: BIX is strictly for microcomputer pros; it contains no "fluff." As a subscriber, here's what you've got coming to you:

- ☐ All the information and ideas exchanged in more than 150 microcomputer-related conferences—a give-and-take in which you can participate.
- ☐ *Microbytes Daily*—up-to-the-minute industry news and new product information.
- ☐ Plus support from hardware vendors and software publishers, access to extensive software libraries, and the use of our electronic mail service—which allows *binary attachments.*

Subscribe to BIX right now—using your computer and modem
Set your telecommunications program for full duplex, 7 bits, even parity, 1 stop bit. Call BIX directly on our special registration-only number: 800-225-4129 (in Massachusetts, call 617-861-9767). Then hit the return key, and respond as follows:

Prompt:	**You Enter:**
login (enter "bix"):	bix
Name?	bix.flatfee

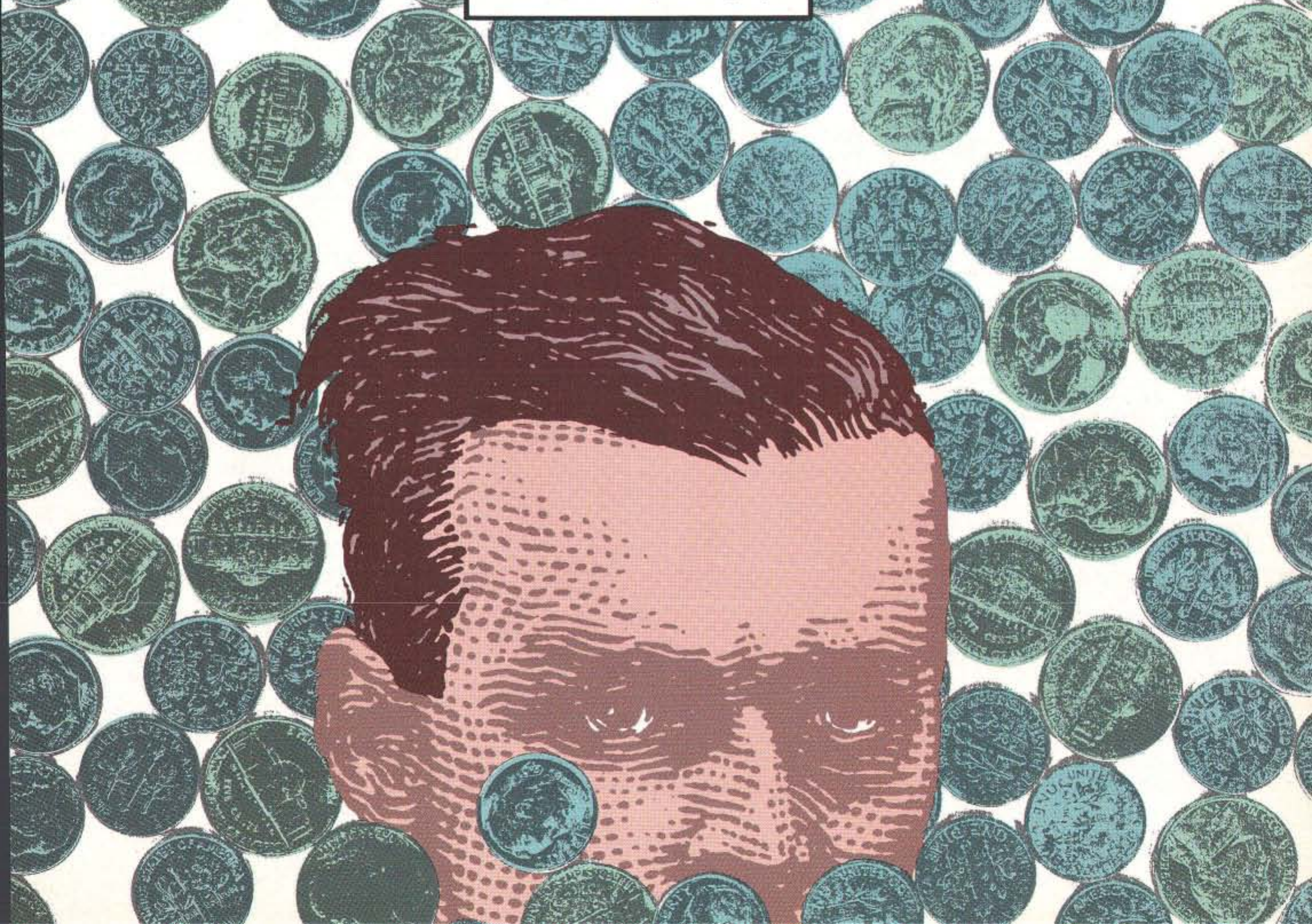
You can charge your BIX subscription to major credit cards, or have it billed to your company.

You may also purchase unlimited off-peak access via Tymnet for just $20 per month, or $3 per off-peak hour, in the continental US.** For more information, and your local Tymnet access number, call 800-227-2983 (in NH and outside the US, call 603-924-7681).

**Based on a $156 annual fee, billed quarterly. You may cancel at any time. If you prefer, you may subscribe for a 3-month trial at just $59. Fee does not include Tymnet connect charges.*

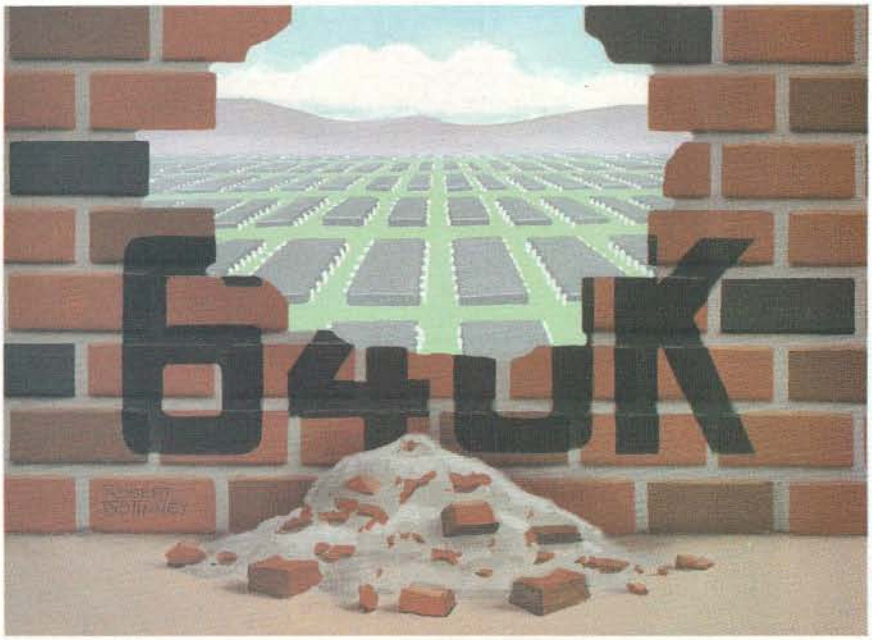
***No extra charge for 2400-baud access. Tymnet prices are subject to change. International networks access BIX at NUI 310690157800.*

BIX
One Phoenix Mill Lane
Peterborough, NH 03458
800-227-2983. In NH 603-924-7681.



GATEWAYS TO PROTECTED MODE

DOS extenders offer the best of two worlds: DOS compatibility and access to protected mode



For programmers and users of Intel-based microcomputers, the architectural legacy of the IBM PC is a blessing and a curse. No other industry-standard architecture enjoys as wide a variety of polished prepackaged software, useful utilities, and high-powered development tools.

However, few architectures have as many restrictions and limitations. The most hobbling of these are the formidable 640K-byte barrier, which prevents programs, data, and DOS from using more than 640K bytes of directly accessible memory, and the 64K-byte limit on memory segment size, which requires programs to perform special gymnastics to manipulate large data objects.

Both limitations arise from the design of the original PC and its CPU, the Intel 8088. The 8088's address space contains only 1 megabyte, and only 640K bytes of this was made available for programs and data on the PC. Despite the introduction of the 286, which can address up to 16 MB of RAM, and the 386, which can perform 32-bit arithmetic and address up to 4 gigabytes in a single segment, the need for downward compatibility and lack of a standard operating environment that supports the new features force most users to run these microprocessors as fast 8088s, in what is called real mode.

Seeking to extract more performance from today's faster clones, clever engineers have come up with numerous ways to circumvent these two limitations. Among these are EMS, add-on program switchers and multitaskers, completely new operating systems, and DOS extenders. Each has advantages and disadvantages vis-à-vis features, compatibility, performance, development techniques, and hardware requirements. In this installment of Under the Hood, I'll discuss how DOS extenders work and how they compare to other methods of getting around the PC's limitations.

Why a DOS Extender?

A DOS extender lets a program run in the protected mode of the 286 or 386, while maintaining access to DOS, DOS device drivers, TSR programs, and the IBM PC BIOS. DOS-extender programs can use all the memory in the machine, including extended memory (i.e., the region above the 1-MB address reach of the original 8088). Protected mode costs some speed, typically 5 percent to 10 percent for the enhanced security of "sanity checking" on accesses to memory and I/O devices, but large memory and—on the 386—full 32-bit addressing and arithmetic usually offset that performance hit by a wide margin.

The user of a DOS-extender program starts it from the DOS prompt the same way he or she would run any other program. There's no new environment to learn, and the user need not even be aware that the extender is at work. DOS-extender makers have gone out of their way to ensure that an ordinary DOS application must be modified only in very minor ways to work with the extender; it might even take just a recompilation.

The downside of DOS extenders is that they run only on systems that use 286, 386, and i486 microprocessors. Users of 8088- and 8086-based machines are left out in the cold. And because the machine must switch back to real mode to handle many system interrupts (including timer ticks and keystrokes), some operations are actually slower, especially on the 286. It's possible, in fact, to drop incoming characters when doing serial I/O at 9600 bps. Fortunately, this problem can

continued

be circumvented with special programming techniques.

What are the other options for getting around the PC's limitations, and how do they compare? While a complete discussion of this topic could fill an entire column by itself, I'll now summarize the key methods.

Other Possibilities

Expanded memory is a bank-switching scheme that switches memory in and out of the PC's address space in 16K-byte blocks. Its key advantage is that it's available on most PC compatibles, including those with 8-bit CPUs.

Expanded-memory emulator programs are available to turn the extended memory on an AT clone into expanded memory, and memory managers (e.g., CEMM, QEMM-386, and 386Max) can use the 386 paging unit to do the bank switching.

Expanded memory's main disadvantages are lack of speed (it takes time to switch banks) and the awkwardness of dealing with RAM that's been broken up into 16K-byte chunks. Expanded memory does not provide access to protected mode or the enhanced addressing and math facilities of the 386 chip.

386 operand and address size overrides let a program running on the 386 in real mode use 32-bit arithmetic and enhanced addressing modes. This simple but little-known feature of the 386 can be used to speed up key parts of a computation. I've seen one program that uses operand size overrides to compute the Mandelbrot set five times faster than it could otherwise.

However, this technique may cause compatibility problems with some OEMs' versions of OS/2, specifically those that don't preserve the full 386 registers during a task switch.

Address size overrides let real-mode programs use powerful array-addressing modes with 32-bit offsets and built-in "shift and add" operations. They can also be used to address segments larger than 64K bytes and memory above 1 MB. However, the techniques for doing so are undocumented (and hence unsupported) by Intel; they may disappear in later chips. And, of course, the 286 supports none of these features.

Other operating environments—notably Unix, OS/2, Concurrent DOS, PC-MOS, and QNX—have been developed to support the enhanced architectural features of the newer chips, but users have been loath to migrate to them. Why? Because they're expensive, require large investments in RAM and hard disk space, and lack DOS's phenomenal software base. Rewriting your own code to run under these new environments can be expensive and incredibly time-consuming.

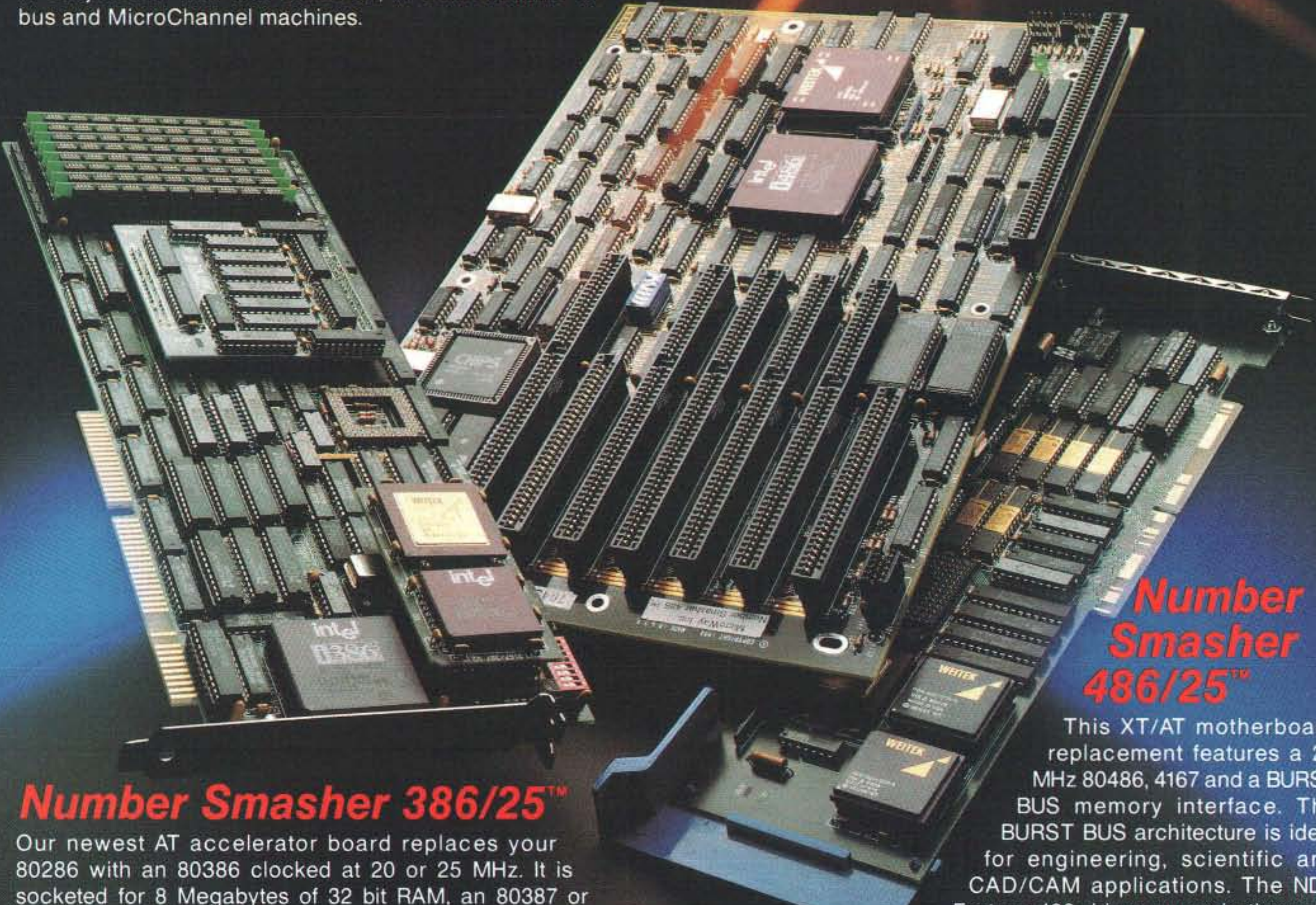
Fortunately, many of these systems have facilities to run DOS programs—or even several at once—as tasks, but they often do it slowly and with limited compatibility. And the DOS programs they do run are still limited to 640K bytes within their individual "virtual machines" or "compatibility boxes."

Add-on multitaskers (e.g., DESQview and VM/386) let multiple DOS applications run simultaneously and offer good DOS compatibility, but they don't offer a full-up enhanced operating-system environment. And the individual programs they run are still subject to the same limitations they'd encounter under DOS. Note, though, that many of these environments now support DOS-extender

continued

Weitek Your 386/486!

The new 4167 delivers up to 10 Megaflops when driven by NDP Fortran-486 and is supported by dozens of scientific, engineering and CAD applications. MicroWay provided the tools to develop many of these applications and supplies the interface cards required to use Weitek coprocessors in conjunction with with an 80387, in both standard AT bus and MicroChannel machines.



Number Smasher 486/25™

This XT/AT motherboard replacement features a 25 MHz 80486, 4167 and a BURST BUS memory interface. The BURST BUS architecture is ideal for engineering, scientific and CAD/CAM applications. The NDP Fortran-486 driven numeric throughput running with the 4167 is 12 Megawhetstones and 10 Megawhetscales (see BYTE 1989 IBM issue).

Number Smasher 386/25™

Our newest AT accelerator board replaces your 80286 with an 80386 clocked at 20 or 25 MHz. It is socketed for 8 Megabytes of 32 bit RAM, an 80387 or 3167 and a 64K SRAM cache. The NDP Fortran-386 driven 3167 throughput at 25 MHz is 5.5 Megawhetstones.

mW3167/387

This popular daughterboard (shown on the Number Smasher 386/25) lets you plug a 3167 and an 80387 into a 386 system that has a single EMC socket.

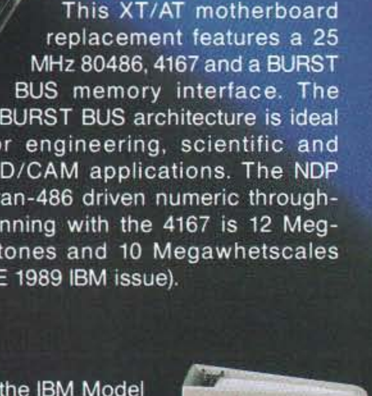
3167/4167 Numeric Performance

	3167/MCA	NS 386/25	NS/486/25
Megawhetstones	3.4	5.5	12.2
Megawhetscales	1.6	3.1	9.9

mW3167/MCA

Our MCA Weitek card runs in the IBM Model 70 and 80. At 20 MHz, its performance is 2 to 3 times that of an 80387.

NDP Fortran-486 and C-486 are globally optimized mainframe compilers that have been fine tuned for the 80486 and 4176.



Micro Way

World Leader in PC Numerics

Corporate Headquarters: P.O. Box 79, Kingston, MA 02364 USA (508) 746-7341
32 High St., Kingston-Upon-Thames, UK., 01-541-5466
USA FAX 508-746-4678 Italy 02-74.90.749 Holland 40 836455 Germany 069-75-2023

applications, thanks to VCPI (see "Stretching DOS to the Limit," *IBM Special Edition*, Fall 1989).

Microsoft Windows provides a graphical user interface as well as some multitasking, but it's hungry for RAM and sucks the wind out of a slow CPU. Applications must be extensively rewritten to take advantage of the GUI, and Windows/386 (at least in its current incarnation) won't coexist with some TSR programs or with DOS extenders.

Inside a DOS Extender

A DOS extender's job is a tricky one. DOS and the BIOS run in real mode. Thus, they perform operations that are illegal in a protected-mode system. The DOS extender filters requests from the application program to the system, as well as any information that comes back. The result: DOS and the BIOS "look" like protected-mode system software to the application, and it looks like a real-mode application to them.

The figure shows, schematically, where the DOS extender fits into the scheme of things. The DOS extender manages and filters communications between the program and other system software. It also performs mode switches as necessary and sets up the descriptor tables (i.e., GDT, LDT, and IDT) that control how memory is used.

Care and Feeding of DOS and the BIOS

To make the BIOS and DOS useful to a protected-mode program, the DOS extender must run the system software in real mode and make it think it's dealing with an ordinary real-mode program. This can require a good deal of work.

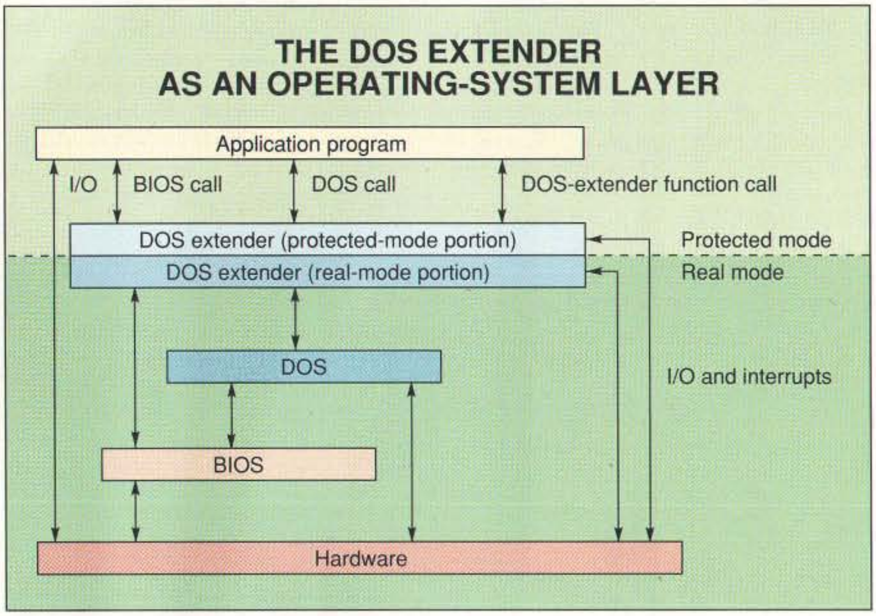
For one thing, DOS and the BIOS don't know how to handle protected-mode addresses. If a DOS or BIOS call requires a pointer to a parameter (as is often the case with disk functions), the protected-mode address furnished by the application (which contains an abstract segment selector and an offset) must be converted to a real-mode address (which contains a physical segment number and an offset).

What's more, since DOS and the BIOS can't access memory above F000:FFFF hexadecimal (the 1-MB limit), any parameters passed in high memory must be either copied down into the lower part of RAM or mapped into it with the 386's paging unit. Likewise, results must often be copied back up to high memory after a call.

Not all DOS extenders have a full repertoire of DOS and BIOS calls, however. For instance, Phar Lap Software's 386/DOS-Extender does not support DOS functions that use file-control blocks, and none automatically supports NetBIOS (although Rational Systems supplies sample source code that can be used to make NetBIOS calls from the DOS extender). Eclipse Computer Solutions' DOS extenders do buffer copying, but they limit it to 16K bytes on many calls.

A DOS extender must handle interrupts in both real and protected modes. Interrupts can arise from three sources: software interrupts (like the ones used to call DOS and the BIOS), hardware interrupts (usually generated by peripherals), and processor exceptions (usually caused by errors in the application). Furthermore, because the IBM PC BIOS disregards Intel's recommendations and uses some "reserved" interrupt vectors for BIOS functions, the extender must also figure out the cause of each interrupt and call the proper routine.

continued



A DOS extender accepts DOS and BIOS calls from a protected-mode application, processes the parameters, and reissues the request in real mode. It also fields interrupts in protected mode (and some in real mode as well), performing mode switches and reissuing interrupt requests as necessary. A DOS-extender application can also have a portion that runs in real mode (not shown), usually for the purpose of handling interrupts without a mode switch.

Turning Off the Engine

One problem that the DOS extender must overcome in each machine is that of switching quickly and nondestructively between real and protected modes. The technique varies with the microprocessor involved. The 286 can be switched from real mode to protected mode in a few instructions. Unfortunately, Intel, in its zeal to make sure that the protection mechanisms on the 286 were secure, provided no way to switch it back! The only way to do so is to reset the microprocessor via a hardware reset line or a particularly nasty sequence of erroneous instructions.

When IBM designed the AT, it noted this problem and provided a hardware workaround for it. An output from the keyboard controller was connected to the main CPU's reset line. The CPU could "commit suicide" by ordering the keyboard controller to toggle the line. The keyboard controller could also be ordered to mask or unmask the 286's A20 address line to simulate the 8088's behavior in real mode.

Some compatibles—including many Compaq machines, systems that use application-specific IC chip sets, and the PS/2s—provide more direct ways of forcing resets and toggling A20. The 386 can be returned to real mode quickly without a reset, and the i486 even provides a pin to notify the internal cache controller that A20 is masked, so that the address used by the cache corresponds to the physical address that appears on the machine's data bus. The bottom line: The time to switch back to real mode can be as short as 30 microseconds on a fast 386 or as long as half a millisecond on a 6-MHz 286.

Protected-Mode Constraints

While the DOS extender is doing its job, the application program must cooperate with it by following the architectural guidelines for protected mode.

As I mentioned in the December 1989 Under the Hood, the most important of these restrictions have to do with memory addresses. A program can access only the memory for which it has a segment selector, and then only in a way that corresponds to the type of the segment. You cannot write to a code segment or execute a data segment (although it is possible to create an *alias*—a writable data segment that overlaps a code segment—if you must).

You can only perform an intersegment jump or call to a "safe" entry point through a call gate. You can't read or write beyond the end of a segment. And you can't trash the operating system by mistake—unless, of course, it chooses to let you do so. If you try to do any of these things, you will get a GP (General Protection) fault, and your program will stop running.

Generally speaking, protection is a good idea. It tends to catch program bugs like wild pointers and out-of-bounds array indexes. Different DOS extenders provide different degrees of protection, however, as you'll see shortly when I look at some actual products.

Virtual Memory

Another advantage of protected mode is the possibility of virtual memory. If you like writing programs that use 64 MB of RAM, and you don't happen to have that much handy, a DOS extender can help. Virtual memory in the 286 must be implemented by swapping whole segments, up to 64K bytes at a time. On the 386, however, the paging unit works with 4K-byte pages.

In either case, a simple least-recently used algorithm is usually sufficient to keep the system from thrashing. All the manufacturers of DOS extenders I've seen either have virtual memory or plan to have it in the near future.

Four DOS Extenders

To gain experience with DOS extenders, I obtained copies of four products: two for the 286 and two for the 386. These included Rational Systems' DOS/16M (the DOS extender that Lotus picked for 1-2-3), Eclipse Computer Solutions' OS/286 and OS/386, and Phar Lap Software's 386/DOS-Extender. To familiarize myself with the development process for each one, I wrote a simple program—the ever-popular "hello world"—in assembly language. It made only two DOS calls: one to function 9 (Write String), and another to function 4C hexadecimal (Terminate Program).

I then built and executed each program, using my own AT clone for the 286 extenders and a 20-MHz 386 system lent to me by Arche Technologies for the 386 extenders. All the programs generated by the 286 extenders also ran on the 386 with no changes, as you might expect.

Although the source code used with both of the 286 extenders was the same, DOS/16M required me to assemble and link an additional module into my code. The purpose of this module was to set up a series of segments for descriptor tables and video screens and to make sure the segments were in the right order.

Building a DOS-Extender Program

For each 286 DOS extender, I used the Microsoft Macro Assembler (MASM)

continued

5.10 and the Microsoft Overlay Linker 3.65 to generate the initial .EXE files and associated .MAP files. (The .MAP files are very important, because they let the postprocessors set up call gates for intrasegment calls.) Both .EXE files ran as ordinary real-mode programs from the DOS prompt. I then passed each through a postprocessor (.EXPress for OS/286 and MAKEPM for DOS/16M), which converted them to a protected-mode format.

To execute the OS/286 program, I loaded the OS/286 kernel as a TSR program by simply typing OS286 at the DOS prompt; I could then execute the "hello world" program by typing UP HELLO. DOS/16M didn't require a resident kernel; I was able to run that version by typing LOADER HELLO.

I assembled the 386 examples with MASM, but I linked each with a 32-bit linker provided by the manufacturer of the DOS extender. I did the version for OS/386 first, and it assembled, linked, and ran on the first try. However, the Phar Lap linker rejected the code with a complaint about a *segment fixup* in the object module. (A segment fixup is used in large-model programs to let the loader insert segment selectors into the code just before it runs.) Phar Lap uses a small—or "flat"—memory model. The one segment used for code, data, and the stack covers all of memory. Its linker and loader therefore don't need to handle the concept of fixups.

I solved the problem by removing a reference to SEG DATA in the source code. The program then linked and ran without a hitch. OS/386, like OS/286, loads the kernel as a TSR program. You use the UP command to run programs. (OS/386 will also run 16-bit protected-mode programs created for OS/286, so you can keep one kernel loaded for both.) Phar Lap provides a loader that's called RUN386 to run its programs. All three DOS extenders came with debuggers. None was of the quality of CodeView or Turbo Debugger, but they all seemed adequate for simple debugging jobs.

Run-Time Environments

Each of the DOS extenders I used presented a slightly different run-time environment to the program. Phar Lap's is the simplest: The code, data, and stack are all mapped into a single large program segment. This segment is normally aliased so that all the segment registers point to it. (Unfortunately, this means that it's very easy for a buggy program to clobber its own code.)

The other three extenders allow multiple segments. The Phar Lap and Rational Systems extenders run all protected-mode code at PL 0, but the Eclipse extenders run the kernel at PL 0 and the user program at PL 3. The latter seems to me to be a wise decision; it's a good idea to take as much advantage as possible of the facilities of protected mode.

High-Level Languages and DOS Extenders

All the DOS extenders I tested came with lists of high-level-language compilers that they supported. (There's no room here to list them all; contact the manufacturers for the most current lists.) Some compiler manufacturers (e.g., MetaWare) work with the DOS-extender manufacturers to make their products compatible; others (e.g., Microsoft) aren't as cooperative and are supported via third-party patches to the run-time libraries. Almost all the patches are workarounds for areas where the run-time libraries access absolute addresses directly, create self-modifying code, or do segment-address arithmetic.

To see what it was like to work with a high-level language under a DOS extender, I tried Meridian Software Systems' AdaVantage Ada compiler and environment, which work with OS/286. Once I got the system installed, I could hardly tell the difference between developing for real and protected modes. The environment "knew" about the DOS extender and behaved appropriately. I was able to get some simple Ada programs running in about an hour.

I tried one more experiment. Eclipse claimed in its manual that the .EXPress program would convert many real-mode programs to run in protected mode, as long as there was no segment arithmetic and the program was reasonably well behaved. I decided to test this by writing a simple Turbo Pascal "hello world" program, generating a .MAP file, and then running the output through .EXPress.

That didn't work, as .EXPress complained that it couldn't find a "Publics by Name" section in the .MAP file (there wasn't one) and quit without producing any output. Daringly, I used a text editor to add the required heading to the .MAP file and tried again. This time—lo and behold!—the conversion worked, and the program ran in protected mode.

Eclipse says that it will soon support Turbo Pascal with a patched run-time library that allows the heap and overlays to work completely.

Compatibility Problems

DOS extenders work hard to make your hardware perform unusual stunts—and

COMPANY INFORMATION

Eclipse Computer Solutions, Inc.
1 Intercontinental Way
Peabody, MA 01960
(508) 535-7510
Inquiry 982.

Phar Lap Software, Inc.
60 Aberdeen Ave.
Cambridge, MA 02138
(617) 661-1510
Inquiry 983.

Rational Systems, Inc.
220 North Main St.
Natick, MA 01760
(508) 653-6006
Inquiry 984.

sometimes the hardware doesn't cooperate. Before you can run Eclipse's OS/286 kernel, you must run a program called Tune, which checks the characteristics of your machine and sets the kernel up to work with it. The documentation warns that Tune may crash the machine a few times as it works, so when this happened on my trusty 8-MHz 286 clone, I calmly rebooted and tried again.

Alas, Tune hung the machine more than 20 times before I stopped trying. It couldn't figure out how things needed to be configured. I therefore called Eclipse, and its technical-support people were very helpful. They gave me a command that forced Tune to configure the kernel as if my machine were a standard AT. The resulting kernel ran with no problems.

What Price Speed?

Each of the DOS extenders I tested lets you "bind" the extender to the loader program to create an .EXE file that can be run directly from the DOS prompt. However, only Rational Systems' package actually included such a utility. The other vendors required you to buy a license before you could use it.

Suppose you're now sold on the idea of using a DOS extender in your application. How much can you expect to pay in royalties? If you have a successful product, you will probably pay a great deal, regardless of which vendor you choose.

Phar Lap charges $1995 for the first 1000 copies and 2 percent of the list price of your program for each copy thereafter.

Rational Systems' DOS/16M, which has a $5000 price tag to start with, comes with a license that lets you distribute 200 copies of your programs. After that, you pay $30 per copy up to the 999th copy and $15 per copy thereafter. If you wish to prepay for some larger number of copies or buy a blanket license, you need to negotiate directly with the company.

Eclipse lets you distribute 2500 copies of your application(s) for a single $10 registration fee, but after that you must pay more, up to a maximum of $15,000.

These prices may be sufficiently daunting to developers that they are inspired to roll their own DOS extenders. While this is a tricky business, it's certainly possible—and even likely—that some will do so. And compiler developers, eager to cash in on the DOS-extender market, may develop extenders exclusively for their own products.

I asked each vendor if its agreement made provisions for distribution of products as shareware; so far, none had. Unfortunately, without special terms for this mode of distribution, it's unlikely that we'll see protected-mode programs written with these DOS extenders in the shareware arena.

The Right Choice?

With OS/2, Windows, Unix, DESQview, DOS extenders, and DOS replacements all competing for pieces of the operating-environment marketplace, DOS extenders have two key advantages. First, they don't require you to run out and buy an expensive piece of software (and possibly hardware to match); second, they provide better performance than most (perhaps all) of the other environments. The 386 DOS extenders run consistently ahead of Unix and OS/2 on virtually all benchmark tests, probably because they eliminate the overhead of a multitasking kernel and scheduler.

I plan to experiment further with DOS extenders as a way of getting more out of my systems and honing my protected-mode programming skills. While vanilla DOS and real mode will surely be around for a long time to come, it's clear that protected-mode programming will play an important role in the future of the Intel-based world. ■

ACKNOWLEDGMENT
Many thanks to Arche Technologies for the loan of a 386 system for use with the 386 DOS extenders.

L. Brett Glass is a freelance programmer, author, and hardware designer residing in Palo Alto, California. He can be reached on BIX as "glass."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

FLIRTING WITH ASSEMBLY

When in Finland, do as the Finnish do; when in assembly, try the same

In *The Mythical Man-Month*, Frederick P. Brooks Jr. estimates that replacing 1 percent to 5 percent of high-level-language code with machine language is the best fix for any speed problem. For many hackers, that's been the most tantalizing of statements. True, a number of high-level languages, notably the ones in Borland's Turbo family, do provide machine language interfaces; but wasn't your reason for mastering one of those languages precisely that you'd be spared a byte-by-byte coping with assembly? If so, then (like me) you may have no grasp of assembly at all, and the luscious fruit Brooks dangles is just out of reach.

All need not be lost. Although I'll not be denying that the more you know the better, I'll offer a case history of how enlightened ignorance can sometimes lead to useful work. A Turbo Pascal program I'd written got speeded by a factor of six when I replaced two short procedures with assembly equivalents. One of them, yes, I copied from a book, but the other I devised on the principle by which a nonspeaker of Finnish might manage to order breakfast in rural Finland: Observe the natives and imitate their ways.

Ignorance can be enlightened by two things: by the fact that all computer languages have structural analogies that the very nature of the computer enforces, and by the fact that once you find a skeleton to flesh out, a few hints from a good book may suffice.

A Dark and Stormy Night

It all started when I needed a program that would locate text strings (words and phrases) in large text files and then tell me where and how often it had found them. Well, don't the MS-DOS utilities offer FIND.EXE? Yes, yes; but FIND doesn't tell you how often it found its quarry; it can tell you on how many distinct lines, which may be quite a different number. Also, for my purposes, FIND has at least two trouble areas.

The first is awkwardness. Each and every search requires a complex command line, where you specify the file to be searched, the string to be sought, refinements like "Ignore letter case" and "Display line numbers," instructions about where the output should go (disk? printer?): in short, much finicky keypushing per search. And I envisaged perhaps dozens of searches per session.

The other trouble with FIND is that you can't make it disregard punctuation. That can cause no end of trouble. Say you want all instances of the word *up* in a file that contains, among other items, the following:

1. go up to
2. Up there
3. puppy
4. Get up!
5. Upset

The instances you want are 1, 2, and 4. FIND's search will locate 1, 3, and 4, overlooking "Up" and including an unwanted "puppy." The same search with the /I switch set (to ignore case distinctions) will locate not only the three items you do want, but also two you don't—items 3 and 5. By prefixing a space to the search string, you could exclude "puppy," and spaces both before and after would exclude "Upset" too; but then the trailing space would make the search miss "Get up!" So can't you somehow suppress punctuation as well as case?

Not, so far as I can see, with the DOS version of FIND. So my next step was to write a Turbo Pascal program, called SEEK, with the following specifications:

1. Just once, at the start, you name the file you plan to search.
2. The program asks you where you want the output: Printer? Disk file? Screen?
3. After that, it asks you for something to find (the Quarry), and each time you supply a Quarry it offers you two options:
   Ignore case distinctions? <y/n>
   Ignore punctuation? <y/n>
4. Output consists of numbered lines containing the Quarry.

If the Quarry appears twice on a line, the line is shown twice. At the end, the program tells you that the Quarry was found *n* times, or else it tells you, "I didn't find [Quarry]." It then asks you for a new Quarry; by answering "~" you can exit to DOS.

Like most no-fuss programs, SEEK devotes much code to getting filenames, error-checking, and other such housekeeping. But once under way, it spends most of its time as follows:

1. Read the next line of text to a string;
2. On a working copy of the string, (a) attach a leading and a trailing space; (b) swamp case differences if required; (c) kill punctuation if required;
3. Search the modified `CopyString` for Quarry; (a) If found, write the original line (numbered) to Outfile. (b) Search further along the string for a recurrence. (c) Found another? Back to 3a. No more? Back to 1.

The Game Is Afoot

I didn't need to write a search algorithm; Turbo Pascal has a very fast POS function to return an integer designating the first appearance of your Quarry in a line. A zero means "not found," so only when

```
POS (Quarry, CopyString) <> 0
```

continued

do you have to do anything more. (What you do is print `LineNumber` and `Line`, then behead `CopyString` right up to the end of the Quarry you've found, and then search what's left anew, just in case your Quarry is present more than once.)

That worked—not as fast as FIND but agreeably fast—so long as I didn't request it to "Ignore case differences" or "Ignore punctuation." In particular, the latter mired SEEK's feet in molasses.

The obvious way to "Ignore case differences" was to put both the Quarry and the working copy of each input line into uppercase. That meant, for each of perhaps many hundred input lines, a FOR loop that ran from 1 to the length of the line, uppercasing characters as necessary. Turbo's UPCASE function made that go a lot faster than it might have; the procedure increased SEEK's run times by some 30 percent, ascribable mostly to loop overhead. Without UPCASE—well, read on.

And the obvious way to "Ignore punctuation" meant a similar FOR loop, to ask each character in the line if it's contained in the set [0..9, a..z, A..Z] and replace it by a space if it isn't. (Quarry also gets a space appended if it hasn't one already; thus, a search for "up" with both options set becomes a search for "UP ," and lo, you find "Get Up!" because it's been transformed into "GET UP "; meanwhile, the space guards us against distraction by "PUPPY.") Neat, yes. But you've no built-in Turbo function to help you, and that loop increases run time by an intolerable 650 percent.

I've since replaced the search function itself with an assembly version derived from Robert Jourdain's book *Turbo Pascal Express*. As published, it had a bug, which Dan Mick fixed for me via BIX. Moreover, so efficient is the Turbo Pascal POS that the speed gain proved unspectacular. Still, it was there.

Closing In on the Quarry

So back to *The Mythical Man-Month*'s rule of thumb: When a program spends most of its time doing one thing over and over, then optimize that routine and watch the sparks fly. Obvious candidates for optimization were perhaps the Line Uppercaser and certainly the Punctuation Killer. To optimize a Turbo Pascal routine, you'd rewrite it in assembly language. But I didn't know assembly.

I did, though, chance to remember a detail from the Turbo Pascal 3.0 manual. To illustrate Turbo's in-line assembly code, it offered a sample procedure that did just what "Ignore case" wanted: converted entire strings to uppercase. So I replaced my Pascal `Procedure UpperCase` with a careful copy of what the manual listed. The assembly version ran so fast that for files of, say, 25K bytes, the difference between ignoring case differences and not ignoring them was nearly unmeasurable. *The Mythical Man-Month* was right; I was on to something.

But could I also deal with punctuation in assembly? How long would it take to learn what I'd need? Weeks, likely, with luck. The payoff, savings measured in seconds, seemed insufficient.

But then two things dawned on me in rapid succession. First, when you need code in a language you don't know, best get it from a book, which was what I'd just done with `Procedure UpperCase`. Second, if you can't find it in a book, look for something structurally similar and work out just the modifications. And that is the secret of flirting with assembly (or any other) language. Let a wizard handle the grunt work. Save your own attention for the details you need.

Something structurally similar? Well, I needed to read in a string, check it character by character, and replace anything that wasn't a numeral or letter with a space. And what does `Procedure UpperCase` do? It reads in a string, checks it character by character, and replaces any lowercase characters with uppercase. That seemed close enough to be promising. Possibly, just by retouching `Procedure UpperCase`, I could come up with machine code for a `Procedure DePunct`. I finally did, and here's a play-by-play.

All Is Revealed

The first step was to gain some understanding of how `Procedure UpperCase` worked. It is listed in full in listing 1. I'll be scrutinizing those mysterious assembly statements toward the right. Any reader fluent in MS-DOS assembly can either look away or relive the struggle.

First to catch the eye is that pair of labels, L1: and L2:. And since assembly items are supposed to jog human memories, an instruction beginning with J is probably a jump. (Yes, a book confirmed that.) Examining the code more closely, you find three jumps up to L1: and one jump clear out to L2:. Coming right after a counter has decremented, that JZ likely means "jump if zero" and jumps you to the exit point. Yes, L2:, at the very bottom, does look like an exit. If so, then the business part of the procedure, its repeated looping and testing, is confined to L1: and below. So the lines down to L1: are doing setup, and you can likely take them over as they stand. (All that turned out to be true.)

Now, how does the testing work? It looks as though the range *a* through *z* is being tested, since a character within that range wants uppercasing. A way to uppercase is to subtract decimal 32 (20 hexadecimal) from the character's ASCII value, and that must be what's happening in the second-to-last line of code, which begins with SUB and ends with 20H. Thereafter, a JMP takes us back up to L1:, which must be where a new character starts getting fetched.

Another detail: Our character is evidently not being checked against all 26 of the letters *a* through *z*. The routine is just looking at boundary conditions. An assembly manual confirms the guess that JA means "jump if above" and JB means "jump if below." "Above" and "below" confused me for a little while. "Below" means "lower in value"—that is, nearer the *top* of the ASCII table. So if the character's ASCII value is less than hexadecimal 61 (*a*), or if it's higher than hexadecimal 7A (*z*), it's not a lowercase letter, and the jump takes us back to L1: to fetch the next candidate.

You can see how this is getting promising: Checking for membership in a range seems quick. Now recall the coarse structure of the ASCII table, where the alphanumeric characters come in just three blocks: decimal 48–57 (the numerals 0 through 9), 65–90 (the uppercased *A* through *Z*), and 97–122 (the lowercased *a* through *z*). You might check your character for membership in each block; keep it if it qualifies or have a space quash it otherwise.

So envisage a label SP: where that space gets substituted, and (as before) label L1: where you get the next character. An automatic jump to L1: should follow SP:. Using "below" the way assembly jargon uses it—to mean "nearer the top of the ASCII table"—pseudocode might look like this:

```
Initialize.
L1: Get a character.
Below 0? Jump to SP:, then to L1:.
Below or equal to 9? Jump to L1:.
Below A? Jump to SP:, then to L1:.
Below or equal to Z? Jump to L1:.
Below a? Jump to SP:, then to L1:.
Below or equal to z? Jump to L1:.
```

Notice that when you've descended as far as *A*, you've already eliminated the numerals, leaving it safe to exclude anything above *A*. Likewise, when you've reached *a*, you've eliminated all capitals as well as all numerals. And the place to put SP: is under the *z* test. That's because

continued

A Refreshing Idea....
A New Standard....
Computing Goes Better With CARRY-I

CARRY-I

The Book Size Computer
The Book you'll read over and over again

CARRY-I 8088

10MHZ XT/AMI BIOS /256K RAM expandable to 640k/One to two 720KB 3.5'' FDD/ Serial/Parallel/Game/CGA/MGA/Standard keyboard connector/16Watt Power adapter
Dimension: 240mm × 185mm × 45mm Weight: 1.9kg-2.4kg

CARRY-I 80286

12MHZ, 0 Wait State AT/AMI BIOS with Diagnostic/1MB RAM/20MB Hard Disk Drive optional /One to two 1.44MB 3.5'' FDD/2 Serial/1 Parallel/CGA/MGA/Standard keyboard connector/30Watt Power adapter
Dimension: 240mm × 185mm × 45mm Weight: 2.1kg-2.8kg

CARRY-I KEYBOARD

82 Key/XT-AT Autoswitch
Dimension: 310mm × 145mm × 27mm

It's priced lower than you'd expect for a PC with this kind of power and portability. But don't take our word for it. Call us today for more information.

FLYTECH

FLYTECH TECHNOLOGY CO., LTD.

HEAD OFFICE:
2 FL., NO. 8, LANE 50, SEC. 3,
NAN-KANG RD., TAIPEI, TAIWAN, R.O.C.
TEL: (02)785-2556 FAX: (02)785-2371
TELEX: 22233 FLTCO

U.S.A. **:**
3008 SCOTT BLVD., SANTA CLARA, CA. 95054 U.S.A.
TEL: (408)727-7373, 727-7374 FAX: (408)727-7375

WEST GERMANY:
MENDELSSOHNSTRASSE 53,
6000 FRANKFURT AM MAIN 1, WEST GERMANY
TEL: (069)746-081, 746-453 FAX: (069)749-375

HONG KONG:
B12, 8 FL., BLOCK B, TONIC INDUSTRIAL CENTRE,
19 LAMHING ST., KOWLOON BAY, KOWLOON,
HONG KONG
TEL: 305-1268 FAX: 796-8427

Circle 117 on Reader Service Card

Listing 1: *The compiler sees only the column at the left, where slashes separate binary instructions and $ is Turbo Pascal's marker for a hexadecimal number; thus,* `$C4` *says what C4h would say in C, and either of them represents decimal 196, or binary 1100 0100. To the right of each statement, between curly brackets, is its assembly equivalent, meant solely for human consumption.*

```
PROCEDURE UpperCase (VAR Strg : LineStr);
   {From Turbo Pascal 3.0 manual, p. 213} BEGIN
    INLINE (
      $C4 / $BE / Strg /          {     LES   DI,Strg[BP]                }
      $26 / $8A / $0D /           {     MOV   CL,ES[DI]                  }
      $FE / $C1 /                 {     INC   CL                         }
      $FE / $C9 /                 {L1:  DEC   CL                         }
      $74 / $13 /                 {     JZ    L2                         }
      $47 /                       {     INC   DI                         }
      $26 / $80 / $3D / $61       {     CMP   ES:BYTE PTR [DI], 'a'      }
      $72 / $F5 /                 {     JB    L1                         }
      $26 / $80 / $3D / $7A /     {     CMP   ES:BYTE PTR [DI], 'z'      }
      $77 / $EF /                 {     JA    L1                         }
      $26 / $80 / $2D / $20 /     {     SUB   ES:BYTE PTR [DI], 20H      }
      $EB / $E9                   {     JMP   SHORT L1                   }
      )                           {L2:                                   }
END; {Procedure UpperCase}
```

Listing 2: *The Turbo Pascal in-line code for a procedure that strips all but alphanumeric characters from a string, replacing suppressed characters by spaces. Jumps are represented by their decimal (not hexadecimal) equivalents; backward (negative) jumps are in two's-complement notation (256 plus the negative value).*

```
PROCEDURE DePunct (VAR Strg : LineStr); BEGIN
    INLINE (
      $C4 / $BE / Strg /          {     LES   DI,Strg[BP]                }
      $26 / $8A / $0D /           {     MOV   CL,ES[DI]                  }
      $FE / $C1 /                 {     INC   CL                         }
      $FE / $C9 /                 {L1:  DEC   CL                         }
      $74 / 44 /                  {     JZ    L2          (+44)          }
      $47 /                       {     INC   DI                         }
      $26 / $80 / $3D / 48 /      {     CMP   ES:BYTE PTR [DI], '0'      }
      $72 / 30 /                  {     JB    SP          (+30)          }
      $26 / $80 / $3D / 57 /      {     CMP   ES:BYTE PTR [DI], '9'      }
      $76 / 239 /                 {     JBE   L1          (-17)          }
      $26 / $80 / $3D / 65 /      {     CMP   ES:BYTE PTR [DI], 'A'      }
      $72 / 18 /                  {     JB    SP          (+18)          }
      $26 / $80 / $3D / 90 /      {     CMP   ES:BYTE PTR [DI], 'Z'      }
      $76 / 227 /                 {     JBE   L1          (-29)          }
      $26 / $80 / $3D / 97 /      {     CMP   ES:BYTE PTR [DI], 'a'      }
      $72 / 06 /                  {     JB    SP          (+6)           }
      $26 / $80 / $3D / 122 /     {     CMP   ES:BYTE PTR [DI], 'z'      }
      $76 / 215 /                 {     JBE   L1          (-41)          }
      $26 / $C6 / $05 / $20 /     {SP:  MOV   ES:BYTE PTR [DI], ' '      }
      $EB / 209                   {     JMP   SHORT L1  (-47)            }
                                  {L2:                                   }
    ) END; {Procedure DePunct}
```

unwanted characters still lurk below *z*, and a descent that gets as far down as those can safely fall through to SP: without further testing.

A Necessary Confrontation

And now it's time to confront the need to write that Turbo Pascal in-line code in hexadecimal. Help is needed here, and the most suave and savvy help around is Jeff Duntemann's *Turbo Pascal Solutions* (Scott Foresman, 1988). After Duntemann has done everything he can to discourage you from even attempting Turbo Pascal in-line code, he offers ample hints, backed up by an invaluable 70-page "Eyeball Assembler."

His most salient hint is this: Unlike real assembly, Turbo Pascal in-line code cannot just jump to a label. It must supply the number of steps in the jump, and "if you miss it by even a single byte, you could be reaching for the power switch." Moreover, *backward* jumps mean negative steps, supplied in two's-complement format. For short jumps, that means just subtracting the number of backward steps from decimal 256, although Duntemann offers a handy hexadecimal table.

The sole thing he doesn't stress sufficiently is that Turbo Pascal in-line code does not *demand* hexadecimal. Converting a decimal count to hexadecimal (or worse, trying to count in hexadecimal) is one more thing that's likely to bollix nonexperts. But it needn't be done. Instead of, say, $2C (Turboese for 2CH), you can just insert plain decimal 44. Blessedly, the compiler won't care. (And how might you obtain decimal 44? As I'll be explaining in a moment, you simply count, kindergarten-style.)

Counting the Steps

Now look at listing 2, which is what I arrived at after some hours. The top five lines are copied straight from `Procedure UpperCase` in the Turbo 3.0 manual. Next, you'll easily spot the checks for the three ranges: 0 through 9, *A* through Z, and *a* through *z*. Once more, their syntax is lifted from the parent program; all I did was supply decimal numbers to mark where the ranges begin and end.

When the character's ASCII number is smaller than the number at the start of the range, then you jump (JB) down to SP:, where a MOV instruction substitutes a space. If you've taken that jump, you're done with this character, and you head back up to L1: to fetch another. If you haven't, you next try a match with the number at the end of the range. This time, if it's equal or smaller, you're within the range, and a jump-if-below-or-equal (JBE) takes you back up to L1:, where you pull in the next candidate from your string, or else you exit to L2: if no more string is left. And if both of those tests have failed, you move to the next range and repeat the process.

It all works perfectly. And fast! An unencumbered search clear through the 42,000 characters in a 750-line text file takes about 10 seconds. Depunctuating every line the Pascal way adds 55 seconds more. But depunctuating by this assembly procedure adds exactly 1 second: a stunning 55-to-1 improvement.

The Final Clue

Now for a few last details. Where did I get the code for JBE, which is not to be found in that parent program? I looked it up in Jeff Duntemann's "Eyeball Assembler," which spells out the hexadecimal codes for every useful assembly combination. That's also where I got the

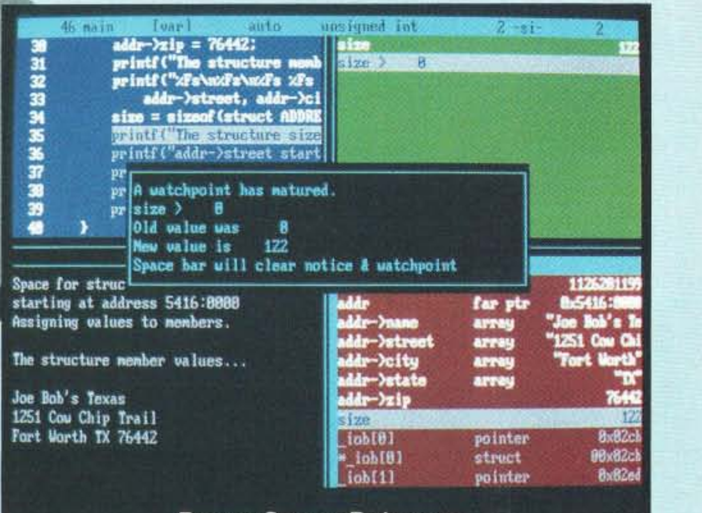
continued

Power C

Incredible Value!

Computer Shopper Best Buy of 1988 · Computer Shopper Best Buy of 1989

Don't take our word for it, take theirs...



Power Ctrace Debugger

"Do you know what the underground bargain C compiler of this year is? It's the Mix Power C compiler. For under $25 with shipping, it is one heck of a good compiler."

Victor Schneider
Dr. Dobb's Journal, June 88 (Letter to the editor)

"Overall, Power C's performance is remarkable for the price. Quite compatible with the Microsoft C and Turbo C "standards", Power C is a heavyweight contender in the educational, hobbyist, and perhaps even the professional market — at a bantamweight price."

Stephen Davis
PC Magazine, September 13, 88 (Review)

"Power C is an unbelievable product for $19.95, and is very competitive with Turbo C, Microsoft C, and Microsoft's new Quick C in both features and performance. It is excellent for the beginner who wants to learn C, or for the experienced programmer who wants to develop professional applications. The manual alone is worth the price of this package, and the generous library source code and assembler offer adds to the value of it. If you have any desire to program in C, or want a more powerful C compiler, get a copy of Power C!"

Michael Cortese
Computer Shopper, August 88 (Review)

"The Ctrace debugger is where Mix really shines. It is magnificent. It's not only better than the stripped down debugger Microsoft includes with Quick C, it's better than the full debugger Microsoft provides with its high-end compiler (Codeview)."

David Weinberger
Computer Shopper, November 88 (Review)

MIX software

Circle 194 on Reader Service Card

Technical Specifications

Power C includes: Power C compiler with integrated Make, Power C Linker, Power C Libraries (450 functions), the Power C book (680 pages), and support for...

- ANSI standard
- IEEE floating point
- 8087/80287 coprocessor
- auto-sensing of 8087/80287
- automatic register variables
- unlimited program size
- mixed model (near & far pointers)
- graphics on CGA, EGA, VGA, & Hercules

Optional Products:

- Power Ctrace debugger
- Library source code
- BCD business math

Order now by calling our toll free number or mail the coupon to Mix Software, 1132 Commerce Drive, Richardson, TX 75081.

1-800-333-0330

For technical support call: 1-214-783-6001

Minimum System Requirements:
DOS 2.0 or later, 320K memory, 2 floppy drives or hard drive.
Runs on IBM PC, XT, AT, PS/2 and compatibles.

60 day money back guarantee

Name ________
Street ________
City ________
State ________ Zip ________
Telephone ________
Paying by: ☐ Money Order ☐ Check
☐ Visa ☐ MC ☐ AX ☐ Discover
Card # ________
Card Expiration Date ________
Computer Name Disk Size ☐ 5¼" ☐ 3½"

Product(s) (Not Copy Protected)
☐ Power C compiler ($19.95) $____
☐ Power Ctrace debugger ($19.95) $____
☐ Library Source Code ($10.00) $____
(includes assembler & library manager)
☐ BCD Business Math ($10.00) $____
Add Shipping ($5 USA – $20 Foreign) $____
Texas Residents add 8% Sales Tax $____
Total amount of your order $____

B

code for the key command

MOV ES:BYTE PTR [DI], ' '

which moves a space into the slot in memory that some unwanted character is occupying. (And no, I did not know that assembly command. I hunted through Duntemann's long list of MOV commands for one that looked like the SUB command I was replacing. You see what I meant about imitating the natives.)

And what about the lengths of all those jumps? The length is inserted as the last element in each jump instruction, and for forward jumps you just count how many elements are to be jumped over. Thus, the code for the last JB SP: ends with a 6, because to get to the start of SP: you must jump over the six machine-code elements in the next two lines. As I mentioned earlier, Turbo Pascal's compiler understands decimal numbers, although purists would prefer that you convert to hexadecimal.

The backward jumps to L1: are a little trickier. Examine the JBE L1:, just after the comparison with 9. Count the jump counter itself as 1, and count backward along each line of machine code until you reach the first instruction ($FE) for L1:, and you'll get 17. Subtract that from 256 to get its two's-complement value, 239. That's your jump counter.

Assembly, My Dear Watson

So, lo, without any real grasp of MS-DOS assembly, you've acquired in-line machine code for a fast `DePunct` procedure. Let me repeat that I'm making no claims for ignorance. I'm certainly prepared to learn that a better assembly version of `DePunct` is possible. But I'm still asserting that a little patience, a little luck, a little analytic effort, and one good book can take you further with an unfamiliar language than you may have imagined you could go. ■

Editor's note: *The Turbo Pascal source code and a compiled version of SEEK are available in a variety of formats. See page 5.*

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

BYTE

PRODUCT SHOWCASE

- BUYER'S MART
- BYTE BITS
- PRODUCT SPOTS
- MICRO PRODUCT CENTER

ILLUSTRATION: JULIE E. MURPHREE © 1989

THE BUYER'S MART
A Directory of Products and Services

THE BUYER'S MART is a monthly advertising section which enables readers to easily locate suppliers by product category. As a unique feature, each BUYER'S MART ad includes a Reader Service number to assist interested readers in requesting information from participating advertisers.

Effective January 1, 1990.

RATES: 1x—$590 3x—$550 6x—$525 12x—$475 24x—$450
Prepayment must accompany each insertion. VISA/MC Accepted.

AD FORMAT: Each ad will be designed and typeset by BYTE. Advertisers must furnish typewritten copy. Ads can include headline (23 characters maximum), descriptive text (250 characters is recommended, but up to 350 characters can be accommodated), plus company name, address and telephone number. Do not send logos or camera-ready artwork.

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call Brian Higgins at 603-924-3754.

ACCESSORIES

SIMMS DIRECT FROM MFG.

*HP LASERJET SERIES II MODULE**PS/2 70 & 80 MODULES*
*LASERWRITER NTH MODULES**MACINTOSH MODULES*
*IBM COMPATIBLE MODULES**AST MODULES*
2 YR WARRANTY
SAVE 60% BUYING DIRECT AND RECEIVE A *FREE* FLOPPY DISK HOLDER AS WELL. MFG. IS ALSO AVAILABLE USING YOUR MEMORY CHIPS. CALL NOW FOR MEMORY NEEDS.

BEPHYR INDUSTRIES, INC.
PH: (714) 951-5193 FAX: (714) 951-1541

Inquiry 576.

NEW! WET RIBBON RE-INKER

Stop discarding expensive printer ribbons. Our Wet Ribbon Re-inker gives you more than 50 better-than-new ribbons for each one you buy!

- Easy to use
- Accommodates most cartridges
- High quality synchronous motor
- Automatic timer
- Satisfaction guaranteed!

BLUE RIBBON INK, LTD.
6803 E. 47th Ave. Dr., Unit D, Denver, CO 80216
(800) 477-3465 (303) 333-8880

Inquiry 577.

CUT RIBBON COSTS!

Re-ink your printer ribbons quickly and easily. Do all cartridge ribbons with just one inker! For crisp, black professional print since 1982. You can choose from 3 models:
Manual E-Zee Inker — **$39.50**
Electric E-Zee Inker — **$94.50**
Ink Master (Electric) — **$189.00**
1000s of satisfied users. Money-back guarantee.

BORG INDUSTRIES
525 MAIN ST., JANESVILLE, IA 50647
1-800-553-2404 Fax: 319-987-2251

Inquiry 578.

80C31 DEVELOPMENT BOARD

Space for 256K x 8 Eprom — 2K x 8 Ram — 8 Bit Output Ports
5V Power thru DB25 — Duplex Serial — PLM Source Code
Currently used as the base controller for: display driver, remote scoreboard, serial/parallel converter, thermal printer controller, transmission line buffer, cartridge storage device and many more!
$99 WITHOUT EPROM — $109 WITH EPROM
CUSTOM FIRMWARE AVAILABLE

COMPUTER ADVICE
515 Calle San Pablo, Camarillo, CA 93010
(805) 482-2002

Inquiry 579.

COMPANION AND EXTENDER

Place a keyboard and monitor up to 600′ from your CPU with EXTENDER and COMPANION products. Keep a second Keyboard/Monitor at the CPU with COMPANION. Supports MDA, CGA, EGA, VGA, PS2. Uses single ⅜″ cable.
Prices start at $149.00 for EXTENDER and $219.00 for COMPANION 25 ft. unit complete.

CYBEX CORPORATION
2800-H Bob Wallace, Huntsville, AL 35805
205-534-0011 International Fax #205-534-0010

Inquiry 580.

ACCESSORIES

FREE CATALOG

A complete source for all your computer supplies — media, paper, cables, furniture, software, ribbons, laser, cleaning & FAX supplies, accessories & much more.
Bulk Diskettes — Minimum Order 50

5.25″ DS/DD 25¢ 3.5″ DS/DD 65¢
5.25″ DS/HD 49¢ 3.5″ DS/HD $1.19

GAAN COMPUTER SUPPLIES
186 B East Sunnyoaks Ave., Campbell, CA 95008
(800) 523-1238, In Calif. (408) 370-6747

Inquiry 581.

Finally a Better Toner Cartridge for your Canon® PC Copier: HP® or Apple® Laser Printer

REFILL KIT IS $19.95 or 3 FOR $50.00 — **SAVE NEARLY $250.00 on average three refills over 4 new cartridges**
New Modified* Toner Cartridges to accept refill kits (*holes are pre-drilled)

PC 3-5 Cartridge	$89.95	HP & Apple Series I, EP, CX	$109.95
PC 6,7 Cartridge	$129.95	HP & Apple Series II, EPS, SX	$109.95
PC 10-25 Cartridge	$99.95	many other Laser Printers that use Canon Engines	

These toner cartridges are modified to easily be refilled up to *three additional times* with our inexpensive do-it-yourself kit. Or use your own empty cartridge and modify yourself with simple instructions in refill kit. Colors also available.

Call: **Morack, Inc.**
9132 Windsor Dr., Palos Hills, IL 60465
Phone: (708) 598-0580 1-800-837-9696 Fax: (708) 598-9203

Inquiry 582.

Printer Buffer: $99.95

256 Kbyte buffer controls complete printing function. Never wait for your printer again. Simply activate buffer and return to any computing task while files are printing.
Serial, parallel, and converter models available to 2 Megabytes (e.g. 512 Kbyte: $129.95). Liberal 30 day return policy and full year limited warranty assure satisfaction!
(513) 644-2230

Technologic Systems
18277 Timber Trails • Marysville, Ohio 43040

Inquiry 583.

AMUSEMENT

RISKY FORTUNE™ $30

POKER — BLACKJACK — CRAPS
TRY YOUR LUCK AGAINST "TOM, DICK & HARRY"™
Play three opponents in **POKER (5 CARD DRAW, JACKS OR BETTER, 3 CARD GUTS, 7 CARD NO PEEK, 5 CARD STUD AND 7 CARD STUD).** Also beat the bank in **BLACKJACK** and **CRAPS.** Eight Games In One. Requirements: MS-DOS, CGA or =, 256K. Hard drive Recommended. Specify: 5¼″ or 3½″ disks and if have hard drive or not. $30 (incl. s&h). VISA/MC or send check or M.O. to:

ASH Software
P.O. Box 781925, Wichita, KS 67278-1925 (316) 788-2834

Inquiry 584.

ARTIFICIAL INTELLIGENCE

NATURAL LANGUAGE C LIBRARY

Increase your market share! Use JAKE to add a natural language front end to your application. JAKE translates English queries and commands into C function calls and data structures. JAKE offers context-sensitive semantic processing; interfaces easily; <64K mem.
JAKE $495. INTERACTIVE DEMO $10

ENGLISH KNOWLEDGE SYSTEMS, INC.
5525 Scotts Valley Dr. #22, Scotts Valley, CA 95066
(408) 438-6922

Inquiry 585.

ARTIFICIAL INTELLIGENCE

NanoLISP $99.99

An MS-DOS Common LISP interpreter that supports most Common LISP operations and strictly adheres to the standard. Numerous advanced and extra features, excellent debugging facilities, sample AI programs, fully-indexed manual, free technical support.

Microcomputer Systems Consultants
P.O. Box 6646, Santa Barbara, CA 93160
(805) 967-2270

Inquiry 586.

muLISP® 87 for MS-DOS

Fast, compact, efficient LISP programming environment. muLISP programs run 2 to 3 times faster & take ½ to ⅓ the space of other LISPs. 450 Common LISP functions, multi-window editing & debugging, flavors, graphics primitives, lessons & help, demo programs, comprehensive manual.

Soft Warehouse, Inc.
3615 Harding Ave., Suite 505, Honolulu, HI 96816
(808) 734-5801

Inquiry 587.

BAR CODE

LABELING SOFTWARE

On EPSON, IBM, OKI dot matrix or LaserJet. Flexible design on one easy screen. Any format/size. Up to 120 fields/label. 18 text sizes to 3″-readable at 100′. AIAG, MIL-STD, 2 of 5, 128, UPC/EAN, Code 39. File Input & Scanned logos/symbols (PCX)—$279. Other programs from $49. 30-day $$ back.

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

BAR CODE READERS

For PC, XT, AT, & PS/2, Macintosh, and any RS-232 terminal. Acts like 2nd keyboard, bar codes read as keyed data. With steel wand—$399. Top rated in independent reviews. Works with DOS, Xenix, Novell, Alloy, -ALL software. Lasers, magstripe, & slot badge readers. 30-day $$ back.

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

PORTABLE READER

Battery-operated, handheld reader with 64K static RAM, 2x16 LCD display, 32-key keyboard, Real-Time-Clock. Wand or laser scanner. Program prompts and data checking through its own keyboard. Easy data transfer by RS-232 port or PC, PS/2 keyboard. Doubles as On-Line Reader. 30-day $$ back.

Worthington Data Solutions
417-A Ingalls St., Santa Cruz, CA 95060
(800) 345-4220 In CA: (408) 458-9938

THE BUYER'S MART

CD-ROM

Largest Selection and Best Price
Microsoft Programmers Library & Drive $949.
Computer Library $695 • Public Domain S/W $49.
NEC PC or Mac Drive Kit $749 • Bookshelf-Best Price!
Drives from $499. Hundreds of titles from $29.
MC/VISA/AMEX/COD, Money-back Guarantee.
Call or write for free 120-page catalog.
Bureau of Electronic Publishing
141 New Road, Parsippany, NJ 07054
800-828-4766
THE SOURCE FOR CD-ROM

Inquiry 604.

A COMPACT DISC SALES AND CONSULTING FIRM
AT SPECIAL

CD ROM Drive, 286-16mhz, 42MB hard drive, 101 keyboard, high resolution monochrome, DOS 4.01 with DOS Extension Software & 3 Titles	**$2,495**
NEC CDR-35 Portable for IBM	**$599**
Hitachi ... Internal **$639**	External **$679**
Toxel DM 3020 ... Retails at $879	Sale **$699**
Toshiba XM 5100 for MAC or IBM	**$749**
Toshiba XM 3201 for MAC or IBM	**$849**

Title special of the month
Word Cruncher ... **$249**

Free Catalog/VISA/MC/AMEX
CD ROM, INC.
1667 Cole Blvd., Suite 400, Golden, CO 80401
TEL: 303-231-9373 **FAX: 303-231-9581** **CIS: 72007,544**

Inquiry 605.

CD-ROM/WORM/ERASABLES
WE BEAT ANY PRICE
CALL FOR LOW, LOW MONTHLY SPECIALS
CD-ROM Drives: HITACHI • NEC • SONY • TOSHIBA • PHILLIPS • DENON • CHINON
Worm Drives: MAXTOR • PANASONIC • PIONEER • TOSHIBA
Erasable Drives: MAXTOR • CANON • SONY
ENORMOUS STOCK of CD-ROM discs, unmatched anywhere!
AMEX/MC/VISA/COD/PO's Welcome
CD-ROM SHOPPER **(201) 866-1666**
Fax (201) 866-9048
1168 Elm Terrace — 24-hr auto order line
Rahway, NJ 07065 — 7 days a week

Inquiry 606.

CD-ROM Publishing Services
Complete CD-ROM publishing services including custom software interface. Reasonable rates, fast turnaround. Call for quote.
Titles published: Food/Analyst, Econ/Stats, Consu/Stats, Agri/Stats.
Hopkins Technology
CD-ROM Publisher
421 Hazel Lane
Hopkins, MN 55343-7117
(612) 931-9376 CIS 74017,614

Inquiry 607.

CD-ROM Developer's Lab
Multimedia production resource for Mac & PC developers & managers. Proven design, management, data prep, programming, premastering, and manufacturing techniques & specs from 18 leading companies. Demos of off-the-shelf tools for imaging, audio, animation (Mac). Real applications using Media—Mixer source tools. CD-ROM XA. PC or Mac $795; Transportable $845. Visa or MasterCard.
Software Mart, Inc.
4131 Spicewood Springs Road I-3, Austin, TX 78759
512-346-7887

Inquiry 608.

YOUR SALES MESSAGE
about the special computer product or service that you provide belongs in print.
THE BUYER'S MART
can help you reach computer professionals and produce valuable inquiries for your company!
Call Brian Higgins for more information
603-924-3754
or
Fax: 603-924-2683

Inquiry 609.

COMMUNICATIONS

PC SDLC SUPPORT
Use Sangoma hardware and software to provide a cost effective, robust and easy to use SDLC link from MS-DOS, XENIX, AIX, PICK, PC-MOS, etc.
All real time communication functions performed by intelligent co-processor card.
X.25 support also available.
Sangoma Technologies Inc.
(416) 474-1990
7170 Warden Avenue #2, Markham, Ontario, Canada L3R 8B2

Inquiry 610.

COMPUTER INSURANCE

INSURES YOUR COMPUTER
SAFEWARE provides full replacement of hardware, media and purchased software. As little as $49 a year provides comprehensive coverage. Blanket coverage; no list of equipment needed. One call does it all. Call 8 am–10 pm ET. (Sat. 9 to 5)
TOLL FREE 1-800-848-3469
(Local 614-262-0559)
SAFEWARE, The Insurance Agency Inc.

Inquiry 611.

COMPUTER UPGRADE

THE COMPLETE XT UPGRADE
The K-311 Upgrade Kit converts your XT to full 32-bit, 20MHz 80386 CPU and high speed disk performance. The K-311 Kit includes 20MHz 80386 w/1Mb RAm, 16-bit Adaptec 1:1 controller, 63Mb 28Ms Mitsubishi disk drive, choice of 1.2 or 1.4Mb diskette drive, Key Tronic 101 Plus keyboard, 200 W PS, new drive cables. Matches or exceeds the performance of a new system but at far less cost. Top quality, easy installation, 1 year warranty. $1,795
5G Corporation
4131 Spicewood Springs Road A-4, Austin TX 78759
800-333-4131 512-345-9843 Fax 512-345-9575

Inquiry 612.

$799 FOR 386-20
$599 FOR 386SX $399 FOR 286-12
Upgrade your computer at a fraction of the cost. Send your computer in, we will do the work. Order now, we will send you a box for mailing your computer. Your old parts will be exchanged for labor charge. We will put in new parts & charge wholesale prices for any parts which do not fit the new system. Prices shown are for motherboard and 1MB RAM. New system available at low prices.
ABTECH Inc.
1431 Potrero Ave., S. El Monte, CA 91733
(800) 992-1978 In Calif. (818) 575-0007

Inquiry 613.

CROSS ASSEMBLERS

CROSS ASSEMBLERS
Universal Linker, Librarian
Targets for 36 Microprocessors
Hosts: PC/MS-DOS, micro VAX, VAX 8000
ENERTEC, INC.
BOX 1312, 811 W. Fifth St.
Lansdale, PA 19446
Tel: 215-362-0966 Fax: 215-362-2404

Inquiry 614.

CROSS ASSEMBLERS/SIMULATORS
Brand new full-function simulator for the 8096 controller, supporting ALL MODES of interrupts plus the HSI, HSO, A/D, and Serial features, with full disassembler; just $300! Our superb simulators for the 8048, 8051, and 8085 sell for $200, and those for the 8052 and Z80 for $250 each.
Our line of cross assemblers for all above target CPUs are also full PC compatible and sell for $100 each. We offer discounts for simulator plus assembler packages.
Lear Com Company
2440 Kipling St./Ste. 206, Lakewood, CO 80215
303-232-2226

Inquiry 615.

CROSS ASSEMBLERS

MACINTOSH CROSS ASSEMBLERS
μASM™—New Version 3.0! Integrated text editor, assembler, and terminal package. S or Hex output downloads to most EPROM programmers. Macros, cond'l ass'y, local & auto labels, symbol table cross-ref. $149.95 each plus S/H. MC/V/AE. Tech. bulletin avail. Most 8-bit MPUs.
30 day money back guarantee.
MICRO DIALECTS, INC., Dept B
P.O. Box 30014, Cincinnati, OH 45230
(513) 271-9100

Inquiry 616.

CROSS ASSEMBLERS
Relocatable
Macros
PC Compatible
GUARANTEED, SUPPORTED
DEBUG SIMULATORS • DISASSEMBLERS
EPROM PROGRAMMERS
MICRO COMPUTER TOOLS CO.
Phone Toll Free (800) 443-0779
In CA (415) 825-4200
912 Hastings Dr., Concord, CA 94518

Inquiry 617.

6800-Family Development Software
Our C Compilers for the 6800, 6801, 6809, & 68HC11 feature a complete implementation (excluding bit fields) of C as described by K&R and yield 30–70% less code than other compilers. Our Assemblers feature macros and conditional assembly. Linker & Terminal Emulator included.
Wintek Corporation
1801 South St., Lafayette, IN 47904
(800) 742-6809 or (317) 742-8428

Inquiry 618.

CROSS COMPILERS

68000 C Compiler
Available under MS-DOS, UNIX and VMS
CrossCode C generates ROMable code for all members of the Motorola 68000 family. It comes with an optimizing compiler, Motorola-compatible assembler, linker, librarian, symbol lister, and universal downloader. *For more info, see our display ad on page 105.*
Call today: 1-800-448-7733
Software Development Systems, Inc.
4248 Belle Aire Lane, Downers Grove, Illinois 60515 USA
Outside USA dial 1-708-971-8170. FAX: 1-708-971-8513

Inquiry 619.

DATA CONVERSION

MEDIA CONVERSION/DATA TRANSLATION
More than just a straight dump or ASCII transfer!
Word Processing, DBMS, and Spreadsheet data on **Disks** or **Tapes** transferred directly into applications running on **Mainframes, Minis, Micros, Dedicated Word Processors, Typesetters,** and **Electronic Publishing** systems.
IBM PS/2 & Macintosh supported
#1 in the translation industry!
CompuData Translators, Inc.
3325 Wilshire Blvd., Suite 1202, Los Angeles, CA 90010
(213) 387-4477 1-800-825-8251

Inquiry 619.

DBMS/COPY
CONVERTS YOUR DATA INTO INFORMATION
Now your favorite stat package can access any database. DBMS/COPY can directly convert any database or spreadsheet file (ORACLE, PARADOX, dBASE, LOTUS etc.) into any stat package file (SAS, SPSS, SYSTAT, etc.) and vice versa. The PLUS version allows sorts, selections, and recalculations. $195. 30-day guarantee. VISA/MC/AMEX/PO/COD. Call for free limited version.
CONCEPTUAL SOFTWARE INC.
P.O. Box 56627, Houston, TX 77256
(713) 667-4222 FAX: (713) 667-3FAX
1-800-STATWOW

Inquiry 620.

THE BUYER'S MART

DATA SECURITY

"We all sincerely believed that when we punched delete, it was gone forever. Wow, were we wrong!"
—Lt. Col. Oliver North, July 7, 1987

DELETE IS NOT COMPLETE!

Use **DATA SHREDDER** - The ultimate security blanket.
From **CORPWARE** - Software that means Business.

CORPWARE, LTD. **800/562-3475**
All elements of ad are tm, sm and/or © 1989 CORPWARE, LTD

Inquiry 621.

DATA/DISK CONVERSION

DISK CONVERSIONS
Media transfer to or from: IBM, Xerox, DEC, Wang, Lanier, CPT, Micom, NBI, CT, Exxon, WRDPLEX also WP, WS, MS/WRD, DW4, MM, Samna, DEC DX, MAS 11, Xerox-Writer, ASCII.

FREE TEST CONVERSION

CONVERSION SPECIALISTS
531 Main St., Ste. 835, El Segundo, CA 90245
(213) 545-6551 **(213) 322-6319**

Inquiry 622.

FROM MACs TO MAINFRAMES. . .
Our 12 conversion systems support over 1000 formats

DISK INTERCHANGE SERVICE COMPANY
2 Park Drive • Westford, MA 01886
(508) 692-0050

Inquiry 623.

BUY YOUR OWN CONVERSION SYSTEM!
With nearly a decade of experience in data conversion, you can work with the industry leader in 9-track tape, cartridge tape and diskette conversion systems. Enjoy the convenience of your own conversion system. Call today to discuss your application!

Flagstaff Engineering
1120 Kaibab Lane, Flagstaff, AZ 86001
(602) 779-3341
MasterCard – Visa – American Express Accepted

Inquiry 624.

THE #1 CHOICE
in disk & tape conversion
for many leading corporations, government agencies, law firms, and companies in every industry—world-wide.
Free test • Satisfaction guaranteed

Graphics Unlimited Inc.
3000 Second St. North, Minneapolis, MN 55411
(612) 588-7571 or (612) 520-2345
FAX: (612) 588-8783

Inquiry 625.

QUALITY CONVERSIONS
to or from virtually
ANY TAPE OR DISK FORMAT!
Horan Data Services converts over 2000 formats incl. 9-track tape and 8", 5¼" or 3½" diskettes. All densities & most operating systems supported. Formats include EBCDIC, ASCII, databases, spreadsheets, and dedicated or PC word processors.

Call 1-800-677-8885
Hours 8:00AM to 5:30PM Eastern Time
817 Main Street, Third Floor, Cincinnati OH 45202

Inquiry 626.

DATA/DISK CONVERSION

***** We RENT conversion systems or DO the conversion for you!*****

Conversion Capabilities: 9 Track Tape, 8" Disk, ¼" Cartridge, Word Processors, Optical Disk, 2.3 Gigabyte Backup, Fax Workstations

WE WILL SOLVE YOUR DATA CONVERSION PROBLEMS!

LIONSGATE DATA SERVICES
CALL: (818) 704-5867 OR FAX: (818) 716-5647

Inquiry 627.

IBM PC ⇐ TO ⇒ HP FILE COPY
FASTER **EASIER TO USE**
Update version uses windows: Call for free demo! IBM PC <to> HP File Copy allows IBM PCs, PS/2, compatibles to interchange files with Hewlett-Packard Series 70, 80, 200, 300, 1000, 9000s.

Oswego Software
Box 310 708/554-3567
Oswego, IL 60543 **FAX 708/554-3573**

Inquiry 628.

CONVERSION SERVICES
Convert any 9-track magnetic tape to or from over 2000 formats including 3½", 5¼", 8" disk formats & word processors. Disk-to-disk conversions also available. Call for more info. Introducing OCR Scanning Services.

Pivar Computing Services, Inc.
165 Arlington Hgts. Rd., Dept. #B
Buffalo Grove, IL 60089 **(800) Hi-Pivar**

Inquiry 629.

DATABASE MGMT SYSTEMS

dBASE file access from C
Code Base 4 is a library of C routines which gives complete dBASE or Clipper functionality and file compatibility. Use DOS, Unix, OS/2 or MS Windows.

$295 with Source! **FREE DEMO**

Sequiter Software Inc.
Call (403) 439-8171 Fax (403) 433-7460

Inquiry 630.

DEMOS/TUTORIALS

INSTANT REPLAY III
Build Demos, Tutorials, Prototypes, Presentations, Music, Timed Keyboard Macros, and Menu Systems. Includes Screen Maker, Keystroke/Time Editor, Program Memorizer, and Animator. Rec'd *Great* Reviews! Simply the BEST. Not copy protected. No royalties. 60-day satisfaction money-back guar. IBM and Compatb. $149.95 U.S.Chk/Cr. Crd. Demo Diskette $5.00.

NOSTRADAMUS, INC.
P.O. Box 9252
Salt Lake City, Utah 84109 **(801) 272-0671**

Inquiry 631.

DISASSEMBLERS

80x86 .EXE/.COM to .ASM
- Accurately reconstruct, study & modify [64K+] programs with a *minimum* of input or editing of output.
- Assembly language output is MASM 5.x-compatible.
- Exhaustive flow-trace distinguishes code from data.
- Best formats for each. Commented BIOS calls/DOS functions. SEGMENT/PROC/other vital pseudo-ops.

PC-DISnDATa (5¼" disk & manual) $165

PRO/AM SOFTWARE
220 Cardigan Road, Centerville, OH 45459
(513) 435-4480 (9 A.M.–5 P.M. EST M–F)

Inquiry 632.

DISASSEMBLERS

SOFT-X-PLORE
See "BYTE's May '88 issue pg. 78." Disassemble 500 kb (*) program at 10,000/min. (*) in any file, ROM/RAM memory up to 80386 instruction set (*). **SOFT-X-plore:**
- * is for MS/DOS 2.0+ systems
- * uses 20 algorithms and seven passes (*)
- * only *$99.95* plus S&H w/30-day guarantee.

To order call **(800) 446-4656** or info **(203) 953-0236**

Or write: **RJSWANTEK INC.**
178 Brookside Rd., Newington, CT 06111
* best on the market MC/VISA accepted

Inquiry 633.

DISK DRIVES

PS/2 DRIVES FOR PCs ATs
CompatiKit/PC **$279**
CompatiKit/AT **$219**
Built-in floppy controllers—no problem. Supports multiple drives and formats. Lets your computer use IBM PS/2 1.4M diskettes *plus more!* Call for further information or to place an order.
VISA/MC/COD/CHECK.

Micro Solutions Computer Products
132 W. Lincoln Hwy., DeKalb, IL 60115 **815/756-3411**
See our ad on page 100.

Inquiry 634.

DISK DUPLICATION

SOFTWARE PRODUCTION
- Disk duplication
- All formats
- EVERLOCK copy protection
- Label/sleeve printing
- Full packaging services
- Warehousing
- Drop shipping
- Fulfillment
- 48-hour delivery
- Consultation & guidance

Star-Byte, Inc.
2880 Bergey Rd., Hatfield, PA 19440
215-997-2470 **800-243-1515**

Inquiry 635.

EDUCATION

B.Sc. & M.S. in COMPUTER SCIENCE
The American Institute for Computer Sciences offers an in-depth correspondence program to earn your Bachelor of Science and Master of Science degrees in Computer Science at home. BSC. subjects covered are: MS/DOS, BASIC, PASCAL, C, Data File Processing, Data Structures & Operating systems. MS program includes subjects in Software Engineering and Artificial Intelligence.

AMERICAN INST. for COMPUTER SCIENCES
1704-BY 11th Ave. So., Birmingham, AL 35205
205-933-0339

Inquiry 636.

Urgently Required
Be a highly paid computer consultant.
We offer a comprehensive training program.
Upon successful completion of the program, we will offer you a license to operate your own business and introduce your business worldwide through our worldwide network.
As we have limited openings, write us today! Send your resume and evaluation fee of $50. USD payable to:

Worldwide Canadian Management Consultant Inc.
P.O.B. 639, Pickering, Canada L1V 3T3

Inquiry 637.

ENTERTAINMENT

CROSSWORD PUZZLE PROGRAM $95
Wordsmith automatically constructs symmetrical crossword puzzles from 40,000 words in user modifiable lists. IBM/Compatible, 640K memory. Hard drive recommended. 5-1/4" or 3-1/2" disks. 30-day money-back guarantee.

COLLINS SOFTWARE
J.L. Collins, Box 110, 875A Island Dr., Alameda, CA 94501

Inquiry 638.

THE BUYER'S MART

ENTERTAINMENT

NEMESIS™ Go Master®

Go, a game of strategic elegance, has been a way of life in the Orient for over four thousand years. Many consider Go to be the secret of the Japanese businessman's success. *"While chess is a game of war, Go is a game of market share"*[President of Nikko Hotels].

"If you are interested in Go, buy this program."
Game of the Month J. Pournelle BYTE 7/87

Toyogo, Inc. *The Leader in Computer Go.*
76 Bedford St. #34-Y, Lexington, MA 02173, (617) 861-0488
1-800-4-TOYOGO

Inquiry 639.

FLOW CHARTS

Flow Charting II+

For IBM and compatibles. It will amaze you with its speed, power and simplicity. 26 standard shapes with over 120 sizes — 10 text fonts — 4 line styles. Place text, lines and shapes anywhere on your chart. For only $229 you'll never draw another chart by hand.

Patton & Patton
81 Great Oaks Blvd., San Jose, CA 95119
1-800-525-0082 Ext. 42 (Outside CA)
408-629-5376 Ext. 42 (CA/Int'l)

Inquiry 640.

WINDOWS FLOWCHARTER $79

RFFlow is a professional drawing tool for flowcharts & org charts (requires Microsoft® Windows). 75 shapes automatically adjust in size. Move, copy, delete groups of objects. 7 levels of zoom. Move flowcharts to other applications via the Clipboard. Supports Windows printers, plotters, and cartridge or soft fonts. Call for free trial disk.

RFF ELECTRONICS
1053 Banyan Court, Loveland, CO 80538
Phone: (303) 663-5767 FAX: (303) 669-4889

Inquiry 641.

STRUCTURED FLOW CHART

NSChart creates Nassi-Shneiderman (structured) flowcharts from a simple PDL. Key words define structures & text strings appear in the chart. Easy to create, even easier to revise! Automatic chart sizing, text centering. Translators from many languages available. For Mac and IBM PC.

SILTRONIX, INC.
P.O. Box 82544, San Diego, CA 92138
1-800-637-4888

Inquiry 642.

FREE COMPUTER MAGAZINES

FREE SUBSCRIPTIONS To More Than 200 Magazines

Don't spend a fortune on computer, communications or business magazines. The SeaBird Directory lists over 200 titles you can get free and runs on any IBM PC.

For more info. and FREE DEMO DISK, call:
1-800-782-0194
or fax to: 617-863-8684

Inquiry 643.

GRAPHICS

EGAD Screen Print

Prints contents of VGA, EGA, CGA displays on variety of dot-matrix and laser printers. Prints in gray tones or color. Crop box lets you print any region of the screen. Enlarge graphics 1 to 4 times (reduction too). Setup program for picking printer colors, etc. $25.00 Postpaid. Call or write for free catalog.

LINDLEY SYSTEMS
4257 Berwick Place, Woodbridge, VA 22192-5119
(703) 590-8890

Inquiry 644.

GRAPHICS

IMAGE CAPTURE BOARD

Capture images from any VCR or Cam-Corder. Resolution: up to 512 x 480 pixels: 256 Colors or 256 shades of grey. Images may be saved in GIF, PCX, TIFF formats and more. VGA Required. Available for PC/XT/AT and PS/2: **$749.00**
JLaser5. Increase laser printer resolution to 4800 x 300 dpi w/256 grey scale. PS/2: **$599.00** PC/XT/AT: **$399.00**

PEGASYSTEMS **(614) 885-1007**
P.O. Box 713, Westerville, OH 43081

Inquiry 645.

HANDHELD COMPUTER

TURNKEY HANDHELD SYSTEMS

HARDWARE and Customized **SOFTWARE** to give you Solutions, not hassles. Solve your portable computer problems with a system designed for your needs. Our systems approach has aided companies in Banking, Insurance and other fields needing a customized approach.

EXTECH INSTRUMENTS
150 Bear Hill Road
Waltham, MA 02154
(617) 890-7440

Inquiry 646.

HARD DRIVE REPAIR

HARD DRIVE REPAIR

WE WILL REPAIR YOUR HARD DRIVE AT A FRACTION OF THE COST OF REPLACING IT. FAST TURNAROUND!!! CALL FOR DETAILS.

H & W micro, inc.
528-C FOREST PARKWAY
FOREST PARK, GA 30050
(404) 366-1600

Inquiry 647.

DISK DRIVE REPAIR
DATA RECOVERY
SALES of new, remanufactured and removable disk drives
FULL TECHNICAL SUPPORT

ROTATING MEMORY SERVICE
1506 Dell Avenue, Campbell, CA 95008
(408) 370-3113
We buy used drives good or bad

Inquiry 648.

HARDWARE

CHIP CHECKER

- 74/54 TTL + CMOS
- 14/4000 CMOS
- 14-24 Pin Chips
- 8000 Nat. + Signetics
- 9000 TTL
- .3" + .6" IC widths

Tests/Identifies over 650 digital chips with ANY type of output in seconds. Also tests popular RAM chips. IBM-compatible version $259. C128 + C64 version $159.

DUNE SYSTEMS
2603 Willa Dr., St. Joseph, MI 49085
(616) 983-2352

Inquiry 649.

OUTDATED BIOS?

An AWARD ROM BIOS will Update your IBM XT, AT, Clone. Supports:

☆ Enhanced (101/102) Keyboards
☆ 1.44Mb 3.5" Floppies
☆ Expanded Hard Drive Table

1 800-423-3400 or (412) 782-0384

KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 650.

HARDWARE

Macintosh® Parts & Repairs

Programs for the corporate, government, dealer and educational buyer. Call for kit.

Save up to 55% on Mac II CPU

800-274-5343 / 617-891-6851

Pre-Owned Electronics, Inc.
30 Clematis Ave • Waltham, MA 02154
Macintosh is a registered trademark of Apple Computer, Inc.

Inquiry 651.

HARDWARE/ADD-ONS

Call Today
for DRAMATIC Low Pricing
on New Slimms™ Memory Modules
1, 2, 4 and 8 Megabyte 72-pin modules available

TermoTrol Corp.
1888 Century Park East, Suite 1900, L.A., CA 90067
213-284-3242 **800-365-0045**

Inquiry 652.

HARDWARE/CONTROLLERS

EMBEDDED SYSTEMS CONTROLLERS

SC/FOX™PCS (Parallel Coprocessor System) and PCS32 are PC/XT/AT plug-in boards, 16 and 32 bit. 15 MIPS average, 50 MIPS burst. PCS uses the Harris RTX 2000™ 16-bit Forth CPU with 1-cycle multiplier, 14 prioritized interrupts, 3 timer/counters, 8-channel I/O bus. PCS32 uses the new SC32 32-bit Forth CPU.
SC/FOX SBC (Single Board Computer) is an 18 MIPS average, 60 MIPS burst, Eurocard-size RTX 2000 stand-alone computer.
SC/FOX SCSI I/O Plug-on board for PCS or SBC with SCSI, floppy, 56K-baud serial, 16-bit parallel ports, and software drivers.
Forth development software included. Ideal for embedded realtime control, data acquisition, robotics, and signal processing.

SILICON COMPOSERS INC. **(415) 322-8763**
208 California Avenue, Palo Alto, CA 94306

Inquiry 653.

HARDWARE/COPROCESSOR

DIGITAL SIGNAL PROCESSOR

DSP products for the IBM PC/XT/AT based on the TI TMS32010 and TMS320C25 up to 12 MIPS operation. Designed for applications in communications, instrumentation, speech, and numeric processing. Offered with 12 bit 110 KHz A/D and D/A and continuous-to-disk data acquisition & playback option. From $650.

DALANCO SPRY
89 Westland Ave., Rochester, NY 14618
(716) 473-3610

Inquiry 654.

HOME AUTOMATION

COMPUTERIZE YOUR HOUSE!

FREE CATALOG! Do-it-yourself home automation systems bring computerized security, entertainment, convenience and state of the art technology to your home now. Unique X-10, radio, computer interfaces, software, computerized telephones, voice, talking security, lighting, TV, A/V, video observation, and lots more. Easy to install!
Call or write for free catalog!

Home Automation Laboratories
3277 Roswell Road, Suite 300-B, Atlanta, GA 30305
(404) 319-6000 ext. 2# (24 hrs.)

Inquiry 655.

INVENTORY MANAGEMENT

STOCK-MASTER 4.0
Commercial grade inventory management software at micro prices.

- Supports all 12 transaction types
- Trend Analysis
- Quality Control
- Multiple Locations
- Purchase Order Tracking
- Open Order Reporting
- Serial/Lot # Tracking
- Stock Status Reporting
- Activity History Analysis
- Bill of Materials
- Purchase Order Writing
- Order Entry
- Material Requirements
- On Line Inquiry

Applied Micro Business Systems, Inc.
177-F Riverside Ave., Newport Beach, CA 92663 **714-759-0582**

Inquiry 656.

THE BUYER'S MART

PROGRAMMERS TOOLS

FREE BUYER'S GUIDE

Programmer's Connection is an independent dealer representing more than 440 manufacturers with over 1200 software products for IBM and Macintosh personal computers. We have serviced the professional programmer since 1984 by offering sound advice and low prices. Call or write today to receive your **FREE** comprehensive Buyer's Guide.

Programmer's Connection US 800-336-1166
7249 Whipple Ave. NW — Canada 800-225-1166
North Canton, OH 44720 — International 216-494-3781

Inquiry 674.

SPEED FORTRAN DEVELOPMENT AND CUT MAINTENANCE COSTS

FORWARN—Finds common programming errors such as mismatched parameter lists and common blocks, and uninitialized variables. Prints detailed cross-references and call-tree diagrams. **$329**

FORTRAN DEVELOPMENT TOOLS—Includes Pretty (indents, renumbers, changes GOTOs to IF-THEN-ELSES, etc.) and 6 more tools. **$129.**

For IBM PC. Also for UNIX—ask for details.

Quibus Enterprises, Inc.
106 N. Draper Avenue, Champaign, IL 61821
(217) 356-8876

Inquiry 675.

Pascal PrettyPrint

Standardize your Pascal source code with this powerful, full featured reformatting and pagination system. This fully customizable program for all PC Pascals (+OOP):

- Adjusts indent, font and case to show program structure
- Adjusts case by maintaining a standard identifier database
- Provides menu and command line interfaces; on-line help
- Saves time and improves readability

$29.95 + $5 S&H — Visa/MC/Check/MO — (717) 383-1188

Qwikware
P.O. Box 222, Peckville, PA 18452

Inquiry 676.

'C' DOCUMENTATION TOOLS

- **C-CALL** $59 Creates graphic-tree of caller/called structures, and files-vs-procedure table-of-contents
- **C-HDR** $59 Creates/inserts/updates headers for each procedure showing caller/called and identifiers
- **C-LIST** $39 List, action-diagram, reformat programs
- **C-REF** $49 Local/global/parameter cross reference
- **SPECIAL** $149 All 4 plus integrated **C-DOC** version

SOFTWARE BLACKSMITHS INC.
6064 St. Ives Way, Mississauga, ONT Canada L5N-4M1
(416) 858-4466

Inquiry 677.

SIMPLE TOOLKIT FOR X-WINDOW

For any X-Window programmer. Simple, but well-thought-through toolkit provides power and flexibility. Little space-time overhead. Library of popular widgets incl. Great for adding X-Window interface to existing C programs. $54.39 + $3.49 S&H, logarithmic (base 2) pricing for multiuser license. We ship portable C source on DOS disk. You upload to X-Window Unix platform and "make" binaries. Specify 3.5" or 5.25" disk. We fully support what we sell.

Strom Systems, Inc.
9009 Avondale NE H-215, Redmond, WA 98052
206-881-0855

Inquiry 678.

Auto Function Tester A Structured TESTING TOOL for C • Statement & Branch Test Case Coverage • Timing • Self-Documenting • Regression Testing MUCH MORE.......requires MSC v5+, TC v2+ $199
Source Code Catalog A DATABASE for YOUR functions • Language Independent • 30k TSR • Find Functions by CATEGORY, XREF, DESC • PASTE function call • Import/Export • Use Category DICTIONARY and/or FREE FORM entry • AUTO-ADD functions from C or dBase SOURCE • AUTO-ADD functions from MSC compatible LIBS. requires DOS 2.x, 3.x—$99 NETWORK VERS.—$199, add $5 s/h + CA res. 6.25% Tax

Talis Computer Service Inc.
P.O. Box 1539, Nevada City, CA 95959
(916) 265-5777

Inquiry 679.

PROGRAMMERS TOOLS

FAST TITLE SCREENS

Fully automatic, professional title screen generator creates magic with line-drawing characters, fast. Quick Titles 2.0 saves for DBase, QuickBasic, C, WordPerfect, Batch files, BBS, etc. Multiple font, border, sizes and styles. No fussing. $59 U.S. funds.

The Logic Factory
Box 9627
Edmonton, AB, CANADA T6E 5X3

Inquiry 680.

PROTOTYPING

Frustrated with Demo II?

You'll Love

PROTOSCREENS

Powerful Rapid Prototyping Software
Easy to Learn and Use - No Programming
Simulate mainframe, mini, and PC systems
Training available on rapid prototyping

BAILEY & BAILEY Software Corporation
859 East 2850 North — Ogden UT 84414
(801) 782-2345 Credit Cards Overnight Del.

Inquiry 681.

PUBLIC DOMAIN

$3.00 SOFTWARE FOR IBM PC

Hundreds to choose from, word processors, databases, spreadsheets, games, lotto, communications, business, music, bible, art, education, language and useful utilities for making your computer easier to learn. Most programs have documentation on the disk.

Free 125-page catalog.

BEST BITS & BYTES
P.O. Box 8245, Dept-B, Van Nuys, CA 91409
In CA: (818) 764-9503 — 800-245-BYTE

Inquiry 682.

$1 per DISK Sale

20 TOP IBM PC PD/SW DISKS (360K) ONLY $20 + $3 S&H

QubeCalc, EDRAW, AutoMenu, Math Tutor, PC-DOS Help, Baker's Dozen, Languages, EZ-Form, PC-Style, PackDisk, PC-Stock, KidGames, Best Games, Home Inventory, PC-Outline, Form Letters, ImagePrint, SideWriter, PC-Prompt, Best Utilities.

BRIGHT FUTURES INCORPORATED
P.O. Box 1030, East Windsor, CT 06088
FREE CATALOG ($1.50 per disk)

Inquiry 683.

FREE CATALOG

$1 IBM SOFTWARE

For your free 32-page Master Edition catalog featuring the best of IBM Shareware from just $1 each, call or write today!

1-800-338-2118

SOFSOURCE
Box 828, East Lansing, MI 48826

Inquiry 684.

FREE SOFTWARE CATALOG

Low as $1.20/disk
Over 1000 quality IBM software
On 5.25" and 3.5" format
From outside U.S.A., except Canada, please send US $2.00 refundable with order.
For fast service, write to

SOFTSHOPPE
P.O. BOX 3678, Ann Arbor, MI 48106-3678
313-761-7638

Inquiry 685.

PUBLIC DOMAIN

FREE SOFTWARE FOR IBM® PC's

TRY US! Get 15 disks full of our best selling software—**FREE!** Great graphics, programmers utilities, desktop publishing, finance, games, education, plus our 1600 disk catalog. Pay only $5.00 for shipping/handling — VISA/MC/AMEX

INTERNATIONAL SOFTWARE LIBRARY
511-104 Encinitas Blvd. • Encinitas CA 92024
CALL TODAY (619) 942-9998

Inquiry 686.

16 and 32 BIT MICROS

EDUCATIONAL TRAINING SYSTEMS in a notebook with power supply–for the Motorola 68000/68020/68881, TMS32010 DSP, Intel 8086/8087. A/D-D/A Convertors, cross assemblers, serial interfaces with software, complete systems, documentation, schematic, operating system, cables. Starting Prices—$230.00.

Phone URDA, Inc.
1-800-338-0517 or (412) 683-8732

Inquiry 687.

REVIEWS

Find "Hands-on" Reviews in Seconds!

PC Reviews is an easy to use on-line database for NOVICES and PROS who need to locate and read "hands-on" reviews. BYTE, Data Based Advisor, PC Today, PC Magazine, Computer Language, Info World and 35 more included. Natural language front-end helps define search terms. A perfect use for a modem. "Wonderful", say users.

Compatible Technologies Group, Inc.
88 Fulton St. #2400, New York, NY 10038
(212) 463-8989 (201) 653-7688 8-N-1 for FREE DEMO

Inquiry 688.

SECURITY

FIGHT PIRACY!

Since 1986, companies worldwide have been choosing **Az-Tech** security products. If you demand the strongest protection available, why not choose one of these "proven leaders":

- **EVERLOCK** Copy Protection
- **EVERTRAK** Software Security
- **EVERKEY** Hardware "Key" Software Security

For IBM and Compatibles. 30 day money back guarantee. Free info and demo disk available.

Az-Tech Software, Inc.
305 East Franklin, Richmond, MO 64085
(800) 227-0644 (816) 776-2700 Fax: (816) 776-8398

Inquiry 689.

THE ULTIMATE COPY PROTECTION

- Completely Menu Driven
- Defeats all Hardware/Software Copiers
- No Source Code Changes
- Multiple Layering
- No Damaged Media
- Full Hard Disk Support
- Unlimited Metering
- ***FREE*** Demo Disk

Quite Simply The Best Ways To Protect Your Valuable Software Investment

STOPVIEW™ — STOPCOPY PLUS™

BBI COMPUTER SYSTEMS® (301) 871-1094
14105 Heritage La., Silver Spring, MD 20906 — FAX: (301) 460-7545

Inquiry 690.

COP's Copylock II

- Protects on standard diskettes
- Cannot be copied by any device incl. Option Board
- Fully hard disk installable
- Normal back-up of protected programs
- LAN-support
- Creates safe demo version of your software

Standard Version $975, Automatic Version $1950

DANCOTEC Computer
In US: 2835 Sierra Rd., San Jose, CA 95132 — 408-729-8162 or 1-800-344-2545
Int'l: 2880 Bagsvard, Denmark — Phone +45-44440322 Fax: -44440722

Inquiry 691.

THE BUYER'S MART

SECURITY

RID YOUR SYSTEM OF VIRUSES FOR EVER
VIRUSAFE™
The most effective anti-virus system available.
■ Recognizes over 70 viruses—regularly updated. ■ Protection against existing and future viruses. ■ Seeks, identifies and removes known viruses resident in memory and programs. ■ Checks integrity of specified programs for virus related changes. ■ Boot operated memory resident program constantly on guard against new virus attacks.
Price $80. Visa/MC. 30-day money-back guarantee.
EliaShim Microcomputers Inc.
520 W. Hgwy 436, suite #1180-30, Altamonte Springs, FL 32714
TEL: (407) 682-1587. FAX: (407) 869-1409
See us at PC New York Expo, Booth 2565

Inquiry 692.

BIT-LOCK® SECURITY
Piracy SURVIVAL 5 YEARS proves effectiveness of powerful multilayered security. Rapid decryption algorithms. Reliable/small port-transparent security device. PARALLEL or SERIAL port. Complemented by economical KEY-LOK™ and multifeatured COMPU-LOCK™ including countdown, timeout, data encryption, and multiproduct protection. (Dos/Unix/Mac)
MICROCOMPUTER APPLICATIONS
3167 E. Otero Circle, Littleton, CO 80122
(303) 770-1917

Inquiry 693.

1st Defense
ANTI-VIRAL
software
Protect your investment by removing that virus before it strikes.
$59.95
1st Defense Anti-Viral Systems
ModaLogic Incorporated
10474 Broadview Rd., Broadview Hts, OH 44127
(216) 838-5238
MS-DOS 2.11+ • Ohio Residents Add $4.20
Specify either 3½" or 5¼" disk

Inquiry 694.

PC Security "Password"
With All the Computer Security Talk, PASSWORD is the Perfect Security Lock.
Password is a software program providing security for your PC. Password is Easy to understand and Simple to install, requires no reformatting. The boot limit option secures your hard disk. Password provides for up to 100 users with the supervisor controlling access to protected directories. Password is menu-driven with pop-up windows and help screens. The program provides an audit trail of users, and a screen blanking feature.
PASSWORD $99.00 US   Visa, M/C, Amex
Nasdec International Inc.
2704-85 Garry Street, Winnipeg MB Canada R3C 4J5
PH: (204) 956-2798   FAX (204) 943-3702

Inquiry 695.

COPY PROTECTION
The world's leading software manufacturers depend on Softguard copy protection systems. Your FREE DISKETTE introduces you to SuperLock™—invisible copy protection for IBM-PC (and compatibles) and Macintosh.
- Hard disk support
- No source code changes
- Customized versions
- LAN support
- New upgrades available

(408) 773-9680
SOFTGUARD SYSTEMS, INC.
710 Lakeway, Suite 200, Sunnyvale, CA 94086
FAX (408) 773-1405

Inquiry 696.

HANDS OFF THE PROGRAM®
OPERATING SYSTEM SECURITY
Secures subdirectories, files, printers and floppies
Keyboard lock — automatic or manual
Log PC boot, program exec, file opens, login/logouts
Prevents DOS FORMAT and most viruses
Drive A: Boot Protection / Hard Disk Lock
IBM PC or 100% comp. — DOS V3.0+ — $89.95 + $3.75 S/H
SYSTEMS CONSULTING INC.
PO BOX 111209, Pittsburgh, PA 15238
(412) 781-5280

Inquiry 697.

SECURITY

HANDS OFF THE BOARD®
1/2 SIZE SECURITY BOARD
Stop floppy boot — Require password to boot PC
Real-time disk encrypt — prevent boot sector virus
Prevent DOS FORMAT/FDISK and low-level formats
Set hard disk READ ONLY or turn ON/OFF
Turn floppies, printers and COM ports ON/OFF
IBM XT, AT Bus — DOS V3.0+ — $149.95 + $5.00 S/H
SYSTEMS CONSULTING INC.
PO BOX 111209, Pittsburgh, PA 15238
(412) 781-5280

Inquiry 698.

SOFTWARE/ACCOUNTING

PC TIME CLOCK
AutoTime is an Employee Management System that allows you to turn any PC into an Electronic Time Clock. AutoTime provides Time & Attendance, Job Costing, Payroll Interface, and Labor Distribution reporting. Network compatible. Prices start at $495. Other Business Products: Network FAX, Absence Call-In, db-EDI.
Chase Technologies
1617 Kingman Ave., San Jose, CA 95128
(408) 998-2917

Inquiry 699.

dBASE BUSINESS TOOLS
- GENERAL LEDGER
- PURCH ORD/INVNTORY
- ORDER ENTRY
- ACCOUNTS RECVABLE
- JOB COSTING
- JOB ESTIMATING
- BILL OF MATLS
- SALES ANALYSIS
- PAYROLL
- ACCOUNTS PAYABLE

$99 ea. + S&H
dATAMAR SYSTEMS Cred. Card-Check-COD
4876-B Santa Monica Ave.
San Diego, CA 92107 **(619) 223-3344**

Inquiry 700.

AUTO-POST
It's here! A totally integrated business management system for $495. Invoices, statements, payroll, inventory general ledger, proposal, job cost and payables. It runs compiled with dBASE III compatible files. A 100-pg. users manual is included. Demo $9.95 with manual $29.95.
New Serv
1615 Gelhot Dr., Suite 34, Fairfield, OH 45014
Phone: (513) 829-1585

Inquiry 701.

SOFTWARE/BASIC

QuickBASIC 4.5 TOOLS!
Our FREE CATALOG features:
NEW, UPDATED FINALLY! Library with over 400 routines for QB 4.5; XGRAF, the complete graphics package for QB 4.5; Other top-line products from all major vendors.
Call 1-800-423-3400 or (412) 782-0384
KOMPUTERWERK, INC.
851 Parkview Blvd., Pittsburgh, PA 15215

Inquiry 702.

SOFTWARE/BUSINESS

DATA ENTRY SOFTWARE
Full-featured, heads-down data entry with two-pass verification, edit language, operator stats, much more! Designed for the PS/2®, PC, XT, AT or compatibles. Standalone $395. LAN version available.
FREE 30-day trial
Computer Keyes   Tel: 206/776-6443
21929 Makah Rd.   Fax: 206/776-7210
Woodway, WA 98020   USA: 800/356-0203

SOFTWARE/BUSINESS

BLP88—LP w/BOUNDED VARIABLES
A general-purpose system similar to LP88 for solving linear programs with up to 1000 constraints and 5000 bounded or unbounded variables. Build BLP88 into your own programs with compiled Turbo Pascal units. BLP88 reads/writes LOTUS worksheets. Use 1-2-3/Symphony as a matrix generator or post processor. Many other features including interactive and batch operation, spreadsheet LP display and editing, equation processor, problem/basis storage, primal/dual conversion, file I/O, Simplex restart, report generator, sensitivity analysis. $149 with manual and 8087 support. $299 with Turbo Pascal units.
Eastern Software Products, Inc.
P.O. Box 15328, Alexandria, VA 22309
(703) 360-7600

Inquiry 703.

DATA ENTRY
KeyEntry III®, a **complete** Data Entry System that provides all the capabilities for designing data entry applications, controlling data flow, & monitoring/reporting operator activity & performance. Supports LAN and stand-alone environments. Evaluation copy (all programs & documentation) available. Call today for information!
Southern Computer Systems, Inc.
2732 Seventh Avenue South
Birmingham, AL 35233
(800) 533-6879/(205) 251-2985

Inquiry 704.

SOFTWARE/EDUCATION

EASE GRADING BLUES!
Now in its 6th year, **GRADEBOOK II** can: rank students, easy edit, calculate student and class averages, add/drop, excuse absences, assign letter grades, calculate course grades (plus 10 more functions). You can print **8 report types** with 86 options. **You get:** software, support, and manual for only $49.50 ppd. MC/VISA. Specify IBM PC or Apple II. **Order now!**
WREN SOFTWARE, INC.
P.O. BOX 1138, Dept. B, Castle Rock, CO 80104
303/660-0049

Inquiry 705.

SOFTWARE/ENGINEERING

Boolean Logic Simulator
- LOGICSIM—a designer's assistant
- Make your logic equation waveforms visible
- Graphic waveform stimulus editor
- Single, multiple, simple & complex devices
- Multiple clocks for registered eqn's
- For IBM & clones, XT & up, CGA, EGA, VGA
- $89.95 includes 1 yr upgrade support
- $15.00 demo
- VISA, PO, MO, CHK

ARCTOS SYSTEMS CORP.
20 Sandwell Cr., Kanata, Ontario, Canada K2K 1V3
(613) 592-0947

Inquiry 706.

SCADA SYSTEM DESIGN
IBM PC or compatible
Supervisory Control And Data Acquisition modular design software includes interactive screens for sizing RTU parameters, modem speed, etc., extensive tutorial, provision for engineering analysis modules, addressing stability & control and alternative technologies for communications subsystems. $450 Engineering modules priced individually, and described in free catalog.
AURASTAR INFORMATION SYSTEMS, INC.
Suite 620, 12001 N. Central Expressway, Dallas, Texas 75243
(214) 770-1950   Fax (214) 770-1954

Inquiry 707.

Affordable Engineering Software
FREE APPLICATION GUIDE & CATALOG
Circuit Analysis • Root Locus • Thermal Analysis • Plotter Drivers • Engineering Graphics • Signal Processing • Active/Passive Filter Design • Transfer Function/FFT Analysis • Logic Simulation • Microstrip Design • PC/MS-DOS • Macintosh • VISA/MC
BV Engineering Professional Software
2023 Chicago Ave., Suite B-13, Riverside, CA 92507
(714) 781-0252

Inquiry 708.

THE BUYER'S MART

SOFTWARE/GRAPHICS

DoDOT for *Microsoft Windows*

With **DoDOT**, you can:
- Capture screens, windows, dialog boxes, and pull-down menus.
- Convert between various file formats: **TIFF, Postscript, PCX, IMG, GIF, MAC, PIC, PCL, MSP, Clipboard, Bitmap, and more.**
- View and edit image with full color support.
- Print images to wide range of printers: LaserJet, Postscript, and more.

With each purchase, you receive free upgrade and support. Only $129 + $5 S/H!

Halcyon Software 10297 Cold Harbor Ave. Cupertino, CA 95014 tel: (408) 257-0812 fax: (408) 257-2012

Inquiry 726.

POPULAR HGRAPH

SCIENTIFIC 2D & 3D graphic routines for IBM PC, VAX, SUN and Macintosh. Powerful, easy to use. Multiple fonts, device and machine independent. Uses max resolution. Links with FORTRAN, Pascal, C, Modula-2 and QuickBasic. **$119.00**

Custom software development.

UGraph—the graphics editor available now!

HeartLand Software, Inc.
234 S. Franklin, Ames, IA 50010
(515) 292-8216

Inquiry 727.

GRAPHICS PRINTER SUPPORT

AT LAST! Use the PrtSc key to make quality scaled **B&W** or **color** reproductions of your display on *any* dot matrix, inkjet, or laser printer (incl. Postscript) in up to 64 shades of gray or 256 colors. GRAFPLUS supports all versions of DOS with IBM (incl. EGA, VGA, Super VGA), Hercules, or compatible graphics boards. Linkable/OEM versions available. $49.95

Jewell Technologies, Inc.
4740 – 44th Ave. SW, Seattle, WA 98116
(800) 359-9000 x527 (206) 937-1081

Inquiry 728.

FORTRAN PROGRAMMER?

Now you can call 2-D and 3-D graphics routines within your FORTRAN program.

GRAFMATIC:	screen routines	$135.
PLOTMATIC:	plotter driver	135.
PRINTMATIC:	printer driver	135.

For the IBM PC, XT, AT & compatibles. *We support a variety of compilers, graphics bds., plotters and printers.*

MICROCOMPATIBLES
301 Prelude Dr., Dept. B, Silver Spring, MD 20901 USA
(301) 593-0683

Inquiry 729.

GRAPHIC TOOLS LIBRARY

XGLIB: Blazing Fast. User coord., Thick lines & arcs. Polygon Engine. Figure drawing. Splines. Text scale, rotate. Keyb, Mouse. Plots, charts and presentation graphics. Screen print. **$99.**

PC_VDI: Display and Printed graphics. Outline font factory. Pan, Scroll. Includes XGLIB. **NO ROYALTIES.** Take **NOVA PRINVIEW** test. **$395.** ANSI comp. "C", PASCAL, FORT., MS QBASIC & BASIC.

NOVA INC.
2500 W. Higgins Road, #1144 Hoffman Estates, IL 60195 CALL **708-882-4111** FAX **708-882-4173**

Inquiry 730.

IMAGE TOOLS LIBRARY

SCANPRO: Fast Image Graphics. Image Capture. Animation, Bitblt, Scale up-down, Rotate, Mirror, Tile fill. Scroll. Data base. Text & Line draw. Pop-ups. Scaled Print/plot. EMS support and 149 funcs. A better package for .PCX file handling. **$149.** ANSI Comp. Most **"C", PASCAL, FORT.,** MS **BASIC.**
PCXIO: Source Library avail. in "C"/Assembler for read/write & display of .PCX files. **$295.**

NOVA INC.
2500 W. Higgins Road, #1144 Hoffman Estates, IL 60195 CALL **708-882-4111** FAX **708-882-4173**

Inquiry 731.

SOFTWARE/GRAPHICS

VGA ColorWorks™ V2.2

The most advanced image creation and manipulation package available for the VGA. Import/export TIFF, PCX, TARGA images. Edit with over 250,000 colors in multiple hardware resolutions (switchable on-the-fly). Complete set of geometrics and patterns. Special effects include tint, shade, blend, mask, fountains, cut/paste, hardware zoom emulation, . . . much more (over 150 drawing controls). Incl. 44 fonts, drivers for PostScript, HP-LaserJet, HP-PaintJet, Epson LQ/FX. Producing up to 64 grey levels or 4096 colors. $59. Call for our free fully operational demo.

SPG Inc.
PO Box 171008 Hialeah, FL 33017
(305) 362-6602

Inquiry 732.

PC SOFTWARE FOR WORK OR PLAY
$3.00 / DISK

Written by some of the best programmers in the world and delivered to you. From DOS enhancement utilities to adult only, desk top publishing, business/investment, database, word processing, games, etc., etc., etc. Our FREE CATALOG contains hundreds of the best software programs on the market. Your complete satisfaction is guaranteed when ordering from:

SILICON VALLEY FREEWARE
P.O. Box 70397, Sunnyvale, CA 94086
(415) 965-9700

Inquiry 733.

GRAPHICS LIBRARIES for C, FORTRAN, PASCAL & QuickBASIC

- Supports VIDEO, PRINTERS & PLOTTERS.
- Linear, log, polar, smith, bar & pie charts.
- Scalable fonts, line types, markers.
- Multiple plots on a page.
- Over 100 routines with full source code.
- 240 page manual. No royalties.

$295.00 **Sutrasoft** (713) 491-2088
10506 Permian Dr. • Sugar Land, TX 77478

Inquiry 734.

PRINTED GRAPHICS

The GraphLink™ Printer Graphics Toolkit lets your Turbo Pascal programs build and print graphics at the ***printer's resolution!*** 80+ routines emulate Borland Graphics Interface. Supports the most popular laser and dot matrix printers. Only **$125** ($250 for Professional version)! Soon for TC, MS-C, Quick C.

VISITECH SOFTWARE.
D5 3807 Ridgewood Ct., Pittsburgh, PA 15239
(412) 733-4775

Inquiry 735.

SOFTWARE/INVESTMENT

Compare 1,500 "Equity" and/or "Fixed Income" Mutual Funds on IBM or compatible PC. Simple menu commands search and sort 25 info fields. Contains 10 years' activity, updated monthly/quarterly. Data transports to Lotus 1-2-3.

One year quarterly subscription to either "Equity" or "Fixed Income" Funds diskettes only $199; both for $299 plus $3 H&P per diskette. Single diskette @ $69.95 plus $3 H&P. Call 1-800-553-3575 to order or for Free Brochure, or write to:

Business Week Diskettes
Dept. BY190, P.O. 1597, Fort Lee, N.J. 07024

Inquiry 735.

SOFTWARE/LANGUAGES

DRUMA FORTH-83

Break the 64K barrier without speed/space penalty. Powerful, attractively priced. '83 Standard.

- 1Mb+ automated memory management
- Full OS interface, extensive utilities
- On-line documentation, ASCII/block files
- Other products: windows, modules, profiler
- IBM PC/XT/AT & all compatibles

FREE learn/utility disks offered: INQUIRE

DRUMA INC.
6448 Hwy. 290 East E103, Austin, TX 78723
Orders: 512-323-0403 **BBoard: 512-323-2402**

Inquiry 736.

SOFTWARE/MATHEMATICS

MATH EDITING FOR THE PC

$$x_i^2 = \Sigma_{k=0}^{\infty} \left[x_k^{276} \binom{n}{k}\right] + \left(\frac{\int\int F\,ds}{\sqrt[3]{\alpha \pm \beta x}}\right)$$

- *MathEdit constructs math equations to be inserted into WordPerfect, Word, WordStar, and others.*
- *WYSIWYG interface—no codes need to be learned.*
- *MathEdit—**$199***

K-TALK COMMUNICATIONS
30 West First Avenue, Suite 100
Columbus, Ohio 43201
(614) 294-3535

Inquiry 737.

SOFTWARE/MEDICAL

PC HOLTER/ECG SOFTWARE

Provides automated ECG data acquisition, analysis, and report generation. FDA approved for medical applications. Complete report review, edit, and print features. Includes beat superimposition and laser printer support. Utilizes tape cassette or solid-state memory data collection devices. Custom versions for OEMs, VARs and dealers.

Diagnostic Medical Instruments, Inc.
6724 Thompson Road, Syracuse, NY 13211
(800) 544-5500 Ext. 20 FAX: **(315) 437-2005**

Inquiry 738.

Medical Systems with ECS

PPM offers a complete line of medical software ranging from simple insurance claims processing to comprehensive A/R management.
PC CLAIM PLUS–claims processing with ECS to over 100 major insurance carriers–30-day money-back guarantee
THRESHOLD–complete A/R, patient billing, comprehensive practice management statistics
CLAIM NET–Nationwide electronic claims clearinghouse transmits claims to over 100 insurance carriers
Software prices start at $459.00. Dealer inquiries welcome.

Physicians Practice Management
350 E. New York, Indianapolis, IN 46204
800-428-3515 **317-634-8080**

Inquiry 739.

SOFTWARE/PACKAGING

HARD TO FIND COMPUTER SUPPLIES FOR SOFTWARE DEVELOPERS & POWER USERS

Cloth binders & slipcases like IBM's. Vinyl binders, boxes, and folders in many sizes. Disk pages, envelopes, & labels. Low quantity imprinting. Bulk disks. Everything you need to bring your software to market. Disk and binder mailers. Much more! Low Prices! Fast service. Call or write for a **FREE CATALOG.**

Anthropomorphic Systems, Limited
376-B E. Saint Charles Rd., Lombard, IL 60148
1-800-DEAL-NOW **312-629-5160**

Inquiry 740.

SAVE SAVE SAVE SAVE
LET'S TALK PACKAGING

From Disk Labels to Manuals to Shipping Boxes—We are a complete packaging service. Everything you need to market your software. Call for our free catalog.

SOFCOM Printing and Packaging
10305 Reading Rd., Cincinnati, OH 45241
513-563-7136

Inquiry 741.

SOFTWARE/SCANNERS

Optical Character Recognition

Stop retyping: PC-OCR™ software will convert typed or printed pages into editable text files for your word processor. Works with HP ScanJet, Panasonic and most other scanners. Supplied with 18 popular fonts. User trainable: you can teach PC-OCR™ to read virtually any typestyle, incl. foreign fonts. Proportional text, matrix printer output, Xerox copies OK. $385. Check/VISA/MC/AmExp/COD

Essex Publishing Co.
P.O. Box 391, Cedar Grove, NJ 07009
(201) 783-6940

Inquiry 742.

THE BUYER'S MART

SOFTWARE/SCIENTIFIC

Chaos/Nonlinear Dynamics
DYNAMICAL SOFTWARE I and II $250 / $350
Ordinary and Delay Differential Equation Solvers • Bifurcation Diagrams • Basin Boundaries • 2- and 3-D Plotting • Poincaré Sections • Return Maps • Spectral Analysis, Fractal Dimensions, Lyapunov Exponents
CHAOS IN THE CLASSROOM Instructional Programs
Maps and Bifurcations $49.95 Fractals and Julia Sets $59.95
DYNAMICAL SYSTEMS, INC.
P.O. Box 35241, Tucson, AZ 85740, (602) 292-1962

Inquiry 743.

free catalog!
800-942-MATH
Micro Math Scientific Software

Inquiry 744.

SOFTWARE/SORT

OPT-TECH SORT/MERGE
Extremely fast Sort/Merge/Select utility. Run as an MS-DOS command or CALL as a subroutine. Supports most languages and file types including Btrieve and dBASE. Unlimited file sizes, multiple keys and much more! MS-DOS **$149.** OS/2, XENIX, UNIX **$249.**
(702) 588-3737
Opt-Tech Data Processing
P.O. Box 678 — Zephyr Cove, NV 89448

Inquiry 745.

If you can find better sort/merge/select software, buy it!
Sortex
Ultimate in performance and reliability
30-Day Money-Back Guarantee
Only $149.95
Systemat Corporation
231 N. Deerfield Drive, Walnut, CA 91789
PHONE: 714 594 9567 FAX: 714 594 7984

Inquiry 746.

SOFTWARE/UTILITIES

EZ-COPY PLUS™
• Diskette Duplicator
• 2X+ faster than DOS' DISKCOPY!
• All 5.25" and 3.5" formats supported.
Only $129+ s/h.©
EZX Publ., 917 Oakgrove, Ste 101, Houston, TX 77058
Orders (V/MC/AX) & Brochures: 1-800 • USEASYX, xB490
INFO: 1-713-280-9900; BBS: 280-8180; FAX: 280-0525

Inquiry 747.

SOFTWARE/VOICE

MULTI-VOICE® TOOLS
Multi-Voice Tools is a complete development Toolkit for Turbo Pascal to access all the features of the WATSON or DIALOGIC Speech Boards. It is also a high level library of procedures to build MULTI-LINE VOICE RESPONSE systems in minutes. A powerful TELEPHONE ANSWERING program is given as an example with source code.
DIALOGIC 599$, WATSON 99$, Visa/MC
ITI Logiciel
1705 St. Joseph E, Suite 4, Montreal, PQ, Can. H2J 1N1
(514) 861-5988
We can also write your Voice Response application programs.

Inquiry 748.

SPEECH SYNTHESIS

SPEECH SYNTHESIS CHIP
Want the most advanced phoneme synthesis chip available? One flexible enough to generate speech, music and sound effects. . . yet low cost and remarkably easy to use? The ARTIC-263 is all of this and more. . . a versatile, high-quality, phoneme-based, speech synthesizer circuit contained in a single, monolithic, 24-pin, CMOS integrated circuit.
Artic Technologies
55 Park Street, Troy, Michigan 48083
Phone: (313) 588-7370 FAX: (313) 588-2650

Inquiry 749.

STATISTICS

The BASS System™
Why use up 8 meg and 640K just to run a data step on your PC? Now you can run your data step code and statistical procs with a system that takes only 1 meg and 400K (and costs only $399)! Free information:
BASS Institute, Inc.
P.O. Box 349, Chapel Hill, NC 27514
(919) 933-7096 or BB: (919) 968-6755 (N,8,1)

Inquiry 750.

SOLO 3.0 from BMDP
Popular statistics and excellent graphics for the PC. Quick and easy to use. For business professionals, researchers, or students. From the leader in statistical software for over 25 years. Top-notch support. Satisfaction guaranteed! $199 complete with graphics. Call today, VISA or MC.
BMDP Statistical Software, Inc.
1440 Sepulveda Blvd., Suite 316, Los Angeles, CA 90025
(213) 479-7799

Inquiry 751.

Cover all the bases of design . . .
with Methodologist's Toolchest™, a comprehensive package of five programs to aid in research design and analysis. Specifically, these programs offer assistance in sampling, data collection procedures, statistical analyses, experimental design, and measurement and scaling. $499.95+s/h. VISA, MC, AMEX, PO, Checks accepted.
The Idea Works, Inc.
100 West Briarwood, Columbia, MO 65203
1-800-537-4866 FAX 314-445-4589
Outside USA 314-445-4554

Inquiry 752.

Know where you're going?
You will—by using Statistical Navigator™, an expert system that helps you select the best statistic for a problem. Statistical Navigator suggests appropriate analyses and explains how each fits your needs. Version 1.1—$99.95+s/h. VISA, MC, AMEX, PO, Checks accepted.
The Idea Works, Inc.
100 West Briarwood, Columbia, MO 65203
1-800-537-4866 FAX 314-445-4589
Outside USA 314-445-4554

Inquiry 753.

NCSS 5.x Series — $125
Easy-to-use menus & spread sheet. Multiple regression. T-tests. ANOVA (up to 10 factors, rep. measures, covariance). Forecasting. Factor, cluster, & discriminant analysis. Nonparametrics. Cross Tabulation. Graphics: histograms, box, scatter, etc. Reads ASCII/Lotus. Many new add-on modules.
NCSS
865 East 400 North, Kaysville, UT 84037
Phone: 801-546-0445 Fax: 801-546-3907

Inquiry 754.

SYSTEM SOFTWARE

PC Compatible File System
All 'C', very portable, rommable. Add floppy & winchester support to embedded systems, or transfer data to-from pc floppies or partitions from your OS. Full, high quality implementation.
High quality CD-ROM interface software available too.
etc bin systems
20 Higley St., Groton, MA 01450
(508) 448-9340

Inquiry 755.

UNINTERRUPTABLE POWER

HOW TO PROTECT YOUR COMPUTER
And Make It Last Longer
FREE money-saving literature. What you need to know about UPS—uninterruptible power supply. How to get complete protection from power line problems. 350VA through 15KVA models from the world's largest manufacturer of single-phase UPS.
Best Power Technology, Inc.
P.O. Box 280, Necedah, WI 54646
(608) 565-7200 ext. 3853
TOLL FREE (800) 356-5794 ext. 3853
See our Ad on page 335.

Inquiry 756.

UTILITIES

ACCUBACK—BACKUP SYSTEM
Program features (all DOS Systems):
• 100% byte by byte read verification
• Supports absolute file matching
• Purges to DOD standards
• DOS restorable
• Creates active archives that are directly accessible
The most accurate backup system available. Special introductory price: $79.95 plus $4.00 shipping/handling.
AMER TECHNOLOGY SYSTEMS, INC.
DEPT D, 8700 SW 26th, Suite E, Portland Oregon 97219
(503) 245-2948 FAX **(503) 245-0846** VISA/MC

Inquiry 757.

YOUR SALES MESSAGE
about the special computer product or service that you provide belongs in print.
THE BUYER'S MART
can help you reach computer professionals and produce valuable inquiries for your company!
Call Brian Higgins for more information
603-924-3754
or
Fax: 603-924-2683

Inquiry 758.

COPY AT TO PC—BRIDGE-IT 3.5
"CPYAT2PC" RELIABLY writes 360KB floppies on 1.2 MB drives, saving a slot for a second hard disk or tape back-up. Only $79.00 + S/H
"BRIDGE-IT 3.5" is a DEVICE DRIVER supporting 3½" 720KB/1.44MB drives for PC/XT/AT without upgrading DOS/BIOS. Only $39.00 + S/H
BRIDGE-IT 3.5 BUNDLED WITH INTERNAL 1.44MB DRIVE AT $129.00 + S/H VISA/MC/COD UPS B/R
MICROBRIDGE COMPUTERS
655 Sky Way Suite 220, San Carlos, CA 94070
1-415-593-8777(CA) 1-415-593-7675 (FAX)
1-514-845-0818 (CANADA) 1-800-523-8777
0908-260-188 (UK)

Inquiry 759.

DELTA, the better text file comparison tool. Scrollable windowed presentations of file or directory comparisons, with a built-in editor window. Ideal for programmers! Requires DOS 2.0 or higher with at least 384K RAM. A hard disk is recommended. **Order now. $79.**
DEMO available on our BBS
OPENetwork
POWER TOOLS FOR POWER USERS
215 Berkely Pl. (B-1), Brooklyn, NY 11217
718-638-2240 BBS: 718-638-2239

Inquiry 760.

THE BUYER'S MART

UTILITIES

Recover deleted files fast!
Disk Explorer now includes automatic file recovery. You type in the deleted file's name, Disk Explorer finds and restores it. Disk Explorer also shows what's really on disk; view, change or create formats, change a file's status, change data in any sector. MS-DOS **$75** U.S. Check/Credit card welcome.
QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243

COPYWRITE
CopyWrite
Removes
Copy Protection
No more diskettes,
manuals or
codewheels.
1000's of products copied.
US $75
QUAID SOFTWARE LIMITED
45 Charles St. E. 3rd Fl, Dept B.
Toronto, Ontario, Canada M4Y 1S2
(416) 961-8243 Fax (416) 961-6448

Remove Hardware Locks
Software utility allows for the removal of hardware locks. Don't wait for your lock or key device to fail or be stolen. Following packages available:

CADKEY	$99.00	PCAD	$199.00
Microstation	$99.00	Personal Designer	$199.00
MicroCadam	$99.00	SmartCam	$99.00

Call for other products. Visa/MC Welcome
(204) 669-4639
SafeSoft Systems Inc.
191 Kirlystone Way, Winnipeg, MB, Canada, R2G 3B6

Inquiry 761.

AppleWorks ↔ IBM
CROSS-WORKS 2.0 transfers both ways between Apple IIe/IIc/IIgs and IBM PC/XT/AT/PS-2 & compatibles. Exchange AppleWorks with Microsoft Works, WordPerfect, Lotus 1-2-3, and dBase III/IV! Included cable plugs in serial ports for 19,200 baud transfers. Easy menu operation. $99.95 (+ shipping).
Phone (919) 870-5694 for free info packet.
*Soft*Spoken Co., PO Box 18343, Raleigh, NC 27619

Inquiry 762.

Why You Want BATCOM!
BATCOM is a batch file compiler that transforms your .bat files to .exe files to make them faster. BATCOM extends DOS with many new commands so you can read keyboard input, use subroutines, and much more. In addition, BATCOM protects your source code. No royalties! Only $59.95. Order today!
Wenham Software Company
5 Burley St., Wenham, MA 01984
(508) 774-7036

Inquiry 763.

Boot From Drive B:
YWSoft's B:Boot! will boot a PC/XT/AT, PS/2 or compatible from drive B:. If you have a 3.5" and a 5.25" drive, you can now boot from disks of both sizes. Also works for external drives. Works for DOS and non-DOS disks. $19.90 + 2.00 S&H.
YWSoft Co.
P.O. Box 2231, Bloomington, IN 47402
Tel: (812) 857-4772

Inquiry 764.

WORD PROCESSING

We can read 130 languages from Armenian to Zulu
Use SPOT OCR Software with an image scanner and your PC to read 130 foreign languages, typed pages, typeset material, magazines and books into standard text files. Flagstaff Engineering can provide any OCR solution. Call today to discuss your application!
Flagstaff Engineering
1120 Kaibab Lane, Flagstaff, AZ 86001
(602) 779-3341
MasterCard—Visa—American Express Accepted

Inquiry 766.

FARSI / GREEK / ARABIC / RUSSIAN
Hebrew, all European, Scandinavian, plus either Hindi, Punjabi, Bengali, Gujarati, Tamil, Thai, Korean, Viet, or IPA. Full-featured multi-language word processor supports on-screen foreign characters and NLQ printing with no hardware modifications. Includes Font Editor. $355 dot matrix; $150 add'l for laser; $19 demo. S/H in U.S. incl'd. Req. PC, 640K, graphics. 30-day Guarantee. MC/VISA/AMEX
GAMMA PRODUCTIONS, INC.
710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401
213/394-8622 Tlx: 5106008273 Gamma Pro SNM

Inquiry 767.

DuangJan
Bilingual word processor for English and: Armenian, Bengali, Burmese, Euro/Latin/African, Greek, Gujarati, Hindi, Khmer, Lao, Punjabi, Russian, Sinhalese, Tamil, Telugu, Thai, Ukranian, Viet, ... Only $109+$5 s/h (foreign + $12 s/h). Font editor included. For any IBM compatibles with dot-matrix & LaserJet printer. Demo $9+$1 s/h. Visa/MC
MegaChomp Company
3438 Cottman Ave., Philadelphia, PA 19149-1606
(215) 331-2748 FAX: (215) 331-4188

Inquiry 768.

THE BUYER'S MART

YOUR SALES MESSAGE

about the special computer product or service that you provide belongs in print.

To help you reach computer professionals and produce valuable inquiries for your company!

Call Brian Higgins for more information

603-924-3754
or
Fax:
603-924-2683

Inquiry769.

NEW FROM OSBORNE/ McGRAW-HILL

THE BOOKS PASCAL PROGRAMMERS ARE ASKING FOR

Turbo Pascal® DiskTutor *by Werner Feibel*
(Includes 1 Book and 3 Disks)

"...The ideal tool for learning Turbo Pascal and object-oriented programming."
- Philippe Kahn, Borland CEO

This package contains 2 disks providing the essentials of Borland's popular compiler, 1 disk of programming examples, and an easy-to-follow book that guides you step-by-step to mastering Turbo Pascal and object-oriented programming.
$39.95, ISBN: 0-07-881575-4, 500 pp.
Borland•Osborne/McGraw-Hill Programming Series

Turbo Pascal® 5.5: The Complete Reference
by Stephen K. O'Brien
The most complete single resource ever published for all Turbo Pascal 5.0 and 5.5 programmers. Covers every Turbo Pascal command, feature, and programming technique.
$26.95, ISBN: 0-07-881501-0, 900 pp.
Borland•Osborne/McGraw-Hill Programming Series

Using QuickPascal®
by Steven Nameroff
A practical get-up-and-go guide to Microsoft's Pascal with object-oriented programming. Covers beginning concepts to intermediate-level techniques and even some advanced topics.
$24.95, ISBN: 0-07-881520-7, 500 pp.

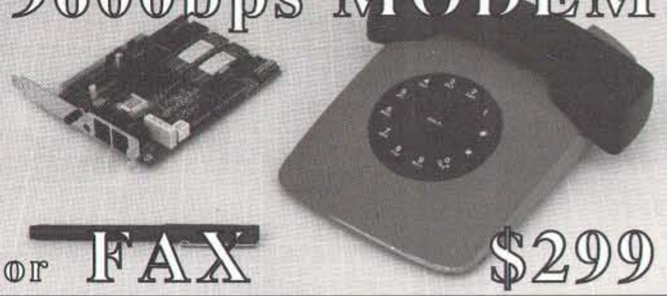
AVAILABLE IN FINE BOOK STORES AND COMPUTER STORES EVERYWHERE
or Call Toll-Free
1-800-262-4729
Mon - Fri 8:30 - 4:30 EST
(Available in Canada through McGraw-Hill Ryerson, Ltd. ph. 416-293-1911)

Osborne**McGraw-Hill**
2600 Tenth Street
Berkeley, CA 94710

 Circle 28 on Reader Service Card

Circle 150 on Reader Service Card (DEALERS: 151)

9600bps MODEM



or FAX $299

300-9600bps MODEM $299
$95-2400bps ALL PRODUCTS...30 DAY FREE TRIAL

The ***SPEEDMODEM*** ™ is a knock out for value and performance. It features DYNAMIC IMPEDANCE STABILIZATION™, ***DIS***™, (patent pending). ***DIS*** improves signal quality, assuring maximum speed and data integrity. ***DIS*** is renowned for superior performance where other modems fail. All products are internal IBM cards, made in USA, 5 year warranty. *If you aren't totally satisfied, return within thirty days for full refund !* ***DISisIT***

	with DIS	no DIS
· ***SPEEDMODEM*** 300-9600-bps	$299	
· ***SPEEDMODEM*** + FAX-9600	$399	
· FAX-9600 full featured high speed fax card	$299	
· 2400-4800-bps MNP-5 MODEM	$193	$169
· 2400-bps MODEM with SEND ONLY FAX	$159	
· 2400-bps MODEM	$119	$95
· FREE $69 EASYCOM™ SOFTWARE with modem		

CompuCom Corporation

March '89 p102 **BYTE MAGAZINE*** ***"Real deal...worked fine...quite a bargain."***

CALL (408) 732-4500 (800) 228-6648

Protect Your Copies of BYTE

NOW AVAILABLE: Custom-designed library *files* or *binders* in elegant blue simulated leather stamped in gold leaf.

Binders—Holds 6 issues, opens flat for easy reading. $9.95 each, two for $18.95, or four for $35.95.

Files—Holds 6 issues. $7.95 each, two for $14.95, or four for $27.95.

Order Now!

Mail to: Jesse Jones Industries, Dept. BY, 499 East Erie Ave., Philadelphia, PA 19134

Please send ________ files; ________ binders for BYTE magazine.

Enclosed is $________________.

Add $1 per file/binder for postage and handling. Outside U.S.A. add $2.50 per file/binder (U.S. funds only please).

Charge my: (minimum $15)

_____ American Express

_____ Visa _____ MasterCard

_____ Diners Club

Card #________________

Exp. Date ________________

Signature ________________

CALL TOLL FREE (24 hours): 1-800-972-5858

Name: ________________

Address: ________________ (No Post Office Box)

City: ________________

State: ________________ Zip: ______

Satisfaction guaranteed. Pennsylvania residents add 6% sales tax. Allow 5-6 weeks delivery in the U.S.

BYTE McGraw-Hill

Only your imagination limits how you benefit from PERCON® keyless data collection.

Checking out books or checking in employees—input data quickly and accurately using bar codes or magnetic stripes. PERCON has proven bar code solutions for IBM®, DEC™, and Apple Macintosh®. Call **1-800-8-PERCON.**

PERCON

2190 W. 11th Avenue, Eugene, Oregon 97402-3503
(503)344-1189 FAX(503)344-1399

REEL 9-TRACK GENIUS

OVERLAND DATA will bring out the *genius in you* when it comes to connecting your PC to the mini/mainframe world. We were the first company to connect 9-track to PCs, and we are still the leaders with the largest installed base worldwide! Call the experts . . . **ODI!**

- Up to 15 MB per minute
- PC/XT/AT/386/PS2 & Compat.
- DOS, XENIX, UNIX, NOVELL
- 800, 1600, 3200, & 6250 BPI
- Outstanding customer support
- 24-hour delivery available
- Cipher, Anritsu, Qualstar & M4

Overland Data
"Experience Makes The Difference"

1-800-PC-9TRAK

5600 Kearny Mesa Road • San Diego, CA 92111
TEL: 619/571-5555 • FAX: 619/571-0982 • 800/729-8725

Mail Order Electronics · Worldwide

Jameco ELECTRONICS®

24 Hour Order Hotline 415-592-8097

SIP & SIMM MODULES

Part No.	Function		Price
512KIT*	IBM PS/2	100ns 256K x 9 SIMM (2 each)	99.95
2MEGKIT*	IBM PS/2	100ns 1MEG x 9 SIMM (2 each)	369.95
41256A9A-10	262,144x9	100ns 256K x 9 SIP (Has Leads)	44.95
41256A9B-80	262,144x9	80ns 256K x 9 SIMM	49.95
421000A8B-10	1,048,576x8	100ns 1MEG x 8 SIMM	109.95
421000A9A-80	1,048,576x9	80ns 1MEG x 9 SIP (Has Leads)	124.95
421000A9B-80	1,048,576x9	80ns 1MEG x 9 SIMM	119.95

*Upgrade for Models 30, 50Z and 60

7400

Part No.	1-9	10+	Part No.	1-9	10+
7400	.29	.19	7474	.39	.29
7402	.29	.19	7475	.49	.39
7404	.29	.19	7476	.45	.35
7405	.35	.25	7483	.59	.49
7406	.39	.29	7485	.65	.55
7407	.39	.29	7486	.45	.35
7408	.35	.25	7489	2.25	2.15
7410	.29	.19	7490	.49	.39
7411	.35	.25	7493	.45	.35
7414	.49	.39	7495	.59	.49
7416	.35	.25	74107	.29	.19
7417	.35	.25	74121	.39	.29
7420	.29	.19	74123	.49	.39
7427	.29	.19	74125	.49	.39
7430	.29	.19	74147	1.99	1.89
7432	.39	.29	74150	1.35	1.25
7438	.39	.29	74151	.39	.29
7442	.49	.39	74154	1.35	1.25
7445	.75	.65	74161	.69	.59
7446	.89	.79	74174	.59	.49
7447	.89	.79	74175	.59	.49
7473	.39	.29	74193	.79	.69

74LS

74LS00	.26	.16	74LS139	.49	.39
74LS02	.28	.18	74LS151	.49	.39
74LS03	.28	.18	74LS153	.49	.39
74LS04	.28	.18	74LS154	1.29	1.19
74LS05	.28	.18	74LS157	.45	.35
74LS06	.59	.49	74LS161	.49	.39
74LS07	.59	.49	74LS163	.49	.39
74LS08	.28	.18	74LS164	.59	.49
74LS09	.28	.18	74LS165	.75	.65
74LS10	.26	.16	74LS166	.89	.79
74LS11	.29	.19	74LS173	.45	.35
74LS14	.49	.39	74LS174	.39	.29
74LS20	.28	.18	74LS175	.39	.29
74LS21	.29	.19	74LS191	.59	.49
74LS27	.35	.25	74LS192	.69	.59
74LS30	.28	.18	74LS193	.69	.59
74LS32	.28	.18	74LS194	.69	.59
74LS38	.35	.25	74LS221	.69	.59
74LS42	.49	.39	74LS240	.59	.49
74LS47	.85	.75	74LS241	.59	.49
74LS73	.39	.29	74LS244	.59	.49
74LS74	.35	.25	74LS245	.79	.69
74LS75	.39	.29	74LS257	.49	.39
74LS76	.39	.29	74LS259	.99	.89
74LS83	.55	.45	74LS273	.89	.79
74LS85	.55	.45	74LS279	.49	.39
74LS86	.29	.19	74LS367	.49	.39
74LS90	.49	.39	74LS373	.79	.69
74LS93	.49	.39	74LS374	.79	.69
74LS123	.49	.39	74LS393	.89	.79
74LS125	.49	.39	74LS541	1.29	1.19
74LS132	.49	.39	74LS590	5.95	5.85
74LS138	.49	.39	74LS688	2.39	2.29

74S/PROMS*

74S00	.25	74S188*	1.49
74S04	.25	74S189	1.49
74S32	.25	74S240	1.39
74S74	.25	74S244	.99
74S112	.25	74S287*	1.49
74S124	1.25	74S288*	1.49
74S138	.49	74S373	.99
74S153	.15	74S374	.99
74S163	.75	74S387*	1.29
74S174	.15	74S472*	2.95
74S175	.39	74S571*	2.49

CD-CMOS

CD4001	.19	CD4051	.59
CD4002	.19	CD4052	.59
CD4007	.19	CD4053	.59
CD4011	.19	CD4060	.65
CD4012	.25	CD4066	.29
CD4013	.29	CD4069	.25
CD4015	.29	CD4070	.29
CD4016	.29	CD4071	.19
CD4017	.49	CD4072	.19
CD4018	.49	CD4073	.19
CD4020	.59	CD4081	.19
CD4021	.49	CD4093	.35
CD4024	.45	CD4094	.89
CD4027	.35	CD4503	.39
CD4028	.49	CD4511	.59
CD4029	.69	CD4518	.75
CD4030	.35	CD4520	.69
CD4040	.65	CD4522	.75
CD4042	.49	CD4528	.69
CD4043	.59	CD4538	.79
CD4046	.65	CD4543	.79
CD4047	.65	CD4584	.49
CD4049	.29	CD4585	.69
CD4050	.29		

NEC V20 & V30 CHIPS

Replace the 8086 or 8088 in Your IBM PC and Increase its Speed by up to 30%

Part No.		Price
UPD70108-5	(5MHz) V20 Chip	5.25
UPD70108-8	(8MHz) V20 Chip	6.95
UPD70108-10	(10MHz) V20 Chip	10.95
UPD70116-8	(8MHz) V30 Chip	7.95
UPD70116-10	(10MHz) V30 Chip	13.49

MICROPROCESSOR COMPONENTS

Z80, Z80A, Z80B, SERIES

Part No.	Price
Z80	1.25
Z80A	1.29
Z80A-CTC	1.65
Z80A-DART	4.95
Z80A-PIO	1.89
Z80A-SIO/O	3.95
Z80B	2.75
Z80B-CTC	3.95
Z80B-PIO	3.95
Z8400HB1 CPU-8MHz	1.95

8000 SERIES

8031	3.95
80C31	8.95
8035	1.25
8039	1.59
8052AHBASIC	24.95
8080A	1.95
8085A	1.95
8085A-2	3.59
8086	3.95
8087 (5MHz)	89.95
8087-1 (10MHz)	169.95
8087-2 (8MHz)	129.95
8088 (5MHz)	4.95
8088-2 (8MHz)	6.95
8155	2.49

8000 SERIES Continued

Part No.	Price
8155-2	3.75
81C55	4.25
8205	9.95
82C11	6.95
8212	1.99
8216	1.39
8224	1.49
8228	1.49
8237-5	4.25
8243	1.95
8250A	4.95
8250B (For IBM)	5.95
8251A	1.95
8253	1.89
8253-5	1.95
82C53-5	3.95
8254	4.95
8255A-5	2.95
82C55A-5	4.49
8256	11.95
8259-5	2.25
8272	3.49
8274	4.75
8279-5	2.95
8282	2.95
8284A	1.95

8000 SERIES Continued

Part No.	Price
8286	2.29
8741	9.49
8742	14.95
8748 (25V)	7.95
8748H (HMOS)(21V)	9.95
8749	9.95
8751H (3.5-12MHz)	34.95
8755	13.95
80286-10 (10MHz)LCC	29.95
80287-3 (5MHz)	109.95
80287-8 (8MHz)	209.95
80287-10 (10MHz)	239.95
80386-16 PGA	249.95
80387-16 (16MHz)	349.95
80387-20 (20MHz)	399.95
80387-25 (25MHz)	499.95
82284 (8MHz)	5.49
82288 (8MHz)	6.95

DATA ACQUISITION

ADC0804LCN	3.25
ADC0808CCN	5.49
ADC0809CCN	3.75
ADC1205CCJ-1	19.95
DAC0808LCN	1.49
AY-3-1015D	4.95
AY-5-1013A	2.95

STATIC RAMS

Part No.	Function		Price
2016-12	2048x8	120ns	2.95
2102	1024x1	350ns	.89
2112	256x4	450ns MOS	2.49
2114N	1024x4	450ns	.99
2114N-2L	1024x4	200ns Low Power	1.49
21C14	1024x4	200ns (CMOS)	.49
5101	256x4	450ns (CMOS)	1.95
6116P-1	2048x8	100ns (16K) CMOS	3.19
6116P-3	2048x8	150ns (16K) CMOS	2.79
6116LP-1	2048x8	100ns (16K) LP CMOS	3.59
6116LP-3	2048x8	150ns (16K) LP CMOS	3.09
6264P-10	8192x8	100ns (64K) CMOS	6.75
6264P-15	8192x8	150ns (64K) CMOS	4.95
6264LP-10	8192x8	100ns (64K) LP CMOS	6.95
6264LP-12	8192x8	120ns (64K) LP CMOS	6.49
6264LP-15	8192x8	150ns (64K) LP CMOS	4.95
6514	1024x4	350ns CMOS	3.25
43256-10L	32,768x8	100ns (256K) Low Power	10.95
43256-15L	32,768x8	150ns (256K) Low Power	9.95
62256LP-10	32,768x8	100ns (256K) LP CMOS	11.95
62256LP-12	32,768x8	120ns (256K) LP CMOS	11.25
62256LP-15	32,768x8	150ns (256K) LP CMOS	10.95

DYNAMIC RAMS

TMS4416-12	16,384x4	120ns	3.95
TMS4416-15	16,384x4	150ns	3.75
4116-15	16,384x1	150ns (MM5290N-2)	1.09
4128-15	131,072x1	150ns (Piggyback)	4.49
4164-100	65,536x1	100ns	2.75
4164-120	65,536x1	120ns	2.39
4164-150	65,536x1	150ns	2.15
41256-60	262,144x1	60ns	5.25
41256-80	262,144x1	80ns	3.75
41256-100	262,144x1	100ns	3.15
41256-120	262,144x1	120ns	2.95
41256-150	262,144x1	150ns	2.59
41264-12	64Kx4	120ns Video RAM	10.95
41464-80	65,536x4	80ns	5.95
41464-12	65,536x4	120ns	3.95
41464-15	65,536x4	150ns	3.59
51258-10	262,144x1	100ns Static Column	8.95
511000P-80	1,048,576x1	80ns (1 Meg)	12.95
511000P-10	1,048,576x1	100ns (1 Meg)	12.35
514256P-10	262,144x4	100ns (1 Meg)	12.95
514258-10	262,144x4	100ns Static Column	26.95

EPROMS

TMS2516	2048x8	450ns (25V)	4.95
TMS2532	4096x8	450ns (25V)	5.95
TMS2532A	4096x8	450ns (12.5V)	5.25
TMS2564	8192x8	450ns (25V)	6.95
TMS2716	2048x8	450ns (-5V, +5V, +12V)	6.49
1702A	256x8	2K (1µs)	4.25
2708	1024x8	450ns	6.95
2716	2048x8	450ns (25V)	3.49
2716-1	2048x8	350ns (25V)	3.95
27C16	2048x8	450ns (25V) CMOS	4.25
2732	4096x8	450ns (25V)	3.95
2732A-20	4096x8	200ns (21V)	3.95
27C32	4096x8	450ns (25V) CMOS	4.25
2764-25	8192x8	250ns (21V)	3.95
2764A-20	8192x8	200ns (12.5V)	4.19
2764A-25	8192x8	250ns (12.5V)	3.49
27C64-15	8192x8	150ns (12.5V) CMOS	4.95
27128-20	16,384x8	200ns (21V)	5.95
27128-25	16,384x8	250ns (21V)	5.25
27128A-15	16,384x8	150ns (12.5V)	6.95
27128A-20	16,384x8	200ns (12.5V)	4.75
27C128-25	16,384x8	250ns (21V) CMOS	5.95
27256-15	32,768x8	150ns (12.5V)	8.49
27256-20	32,768x8	200ns (12.5V)	5.49
27256-25	32,768x8	250ns (12.5V)	4.95
27C256-15	32,768x8	150ns (12.5V) CMOS	7.25
27C256-25	32,768x8	250ns (12.5V) CMOS	5.49
27512-25	65,536x8	250ns (12.5V)	7.25
27C512-15	65,536x8	150ns (12.5V) CMOS	9.95
27C512-25	65,536x8	250ns (12.5V) CMOS	7.49
27C010-15	131,072x8	150ns (12.5V) CMOS (1 Meg)	19.95
68764	8192x8	64K 450ns (25V) (Chip Enable)	14.95
68766-35	8192x8	64K 350ns (25V) (Output Enable)	15.95

EEPROMS

2816A-25	2048x8 250ns (9V-15V) 5V **Read/Write**	5.49
2817A	2048x8 350ns 5V **Read/Write**	6.95
2864A	8192x8 250ns 5V **Read/Write** (Pin 1, No R/B)	10.95
2865A	8192x8 250ns 5V **Read/Write**	10.95

6500/6800 68000 Series

Part No.	Price
6402	3.75
6502	2.19
6502A	2.59
65C02 (CMOS)	6.95
6520	1.59
6522	2.95
65C22	4.25
6532	4.95
6551	2.69
65C802 (CMOS)	15.95
6800	1.75
6802	2.95
6808	2.49
6810	1.25
6820	2.75
6821	1.75
68B21	2.25
6840	3.49
6845	2.75
6850	1.75
6852	.49
MC68000L8	9.95
MC68000L10	11.95
MC68008P8	4.95
MC68010L10	19.95
MC68020RC12B	44.95
MC68450L10	14.95
MC68701	19.95
MC68705P3S	15.95
MC68705U3S	17.95
MC68881RC16A	129.95
MC68881RC20A	139.95

Commodore

WD1770	8.95
SI3052P	.49
6504A	.75
6510	14.95
6526	13.95
6526A	14.95
6545-1	3.95
6560	6.95
6567	24.95
6572	2.95
6581 (12V)	12.95
8502	7.95
8564	2.95
8566	4.95
8701	9.95
8722	4.95
*82S100PLA**	15.95
310654-05	9.95
325572-01	17.95
901225-01	15.95
901226-01	15.95
901227-02	4.95
901227-03	15.95
901229-05	15.95
901460-03	.99
901486-06	1.49

*No specs available
**Note: 82S100PLA = U17 (C-64)

74C/CMOS

74C00	.25	74C174	.39
74C02	.25	74C175	.39
74C04	.25	74C192	.99
74C08	.25	74C194	.25
74C10	.19	74C221	1.79
74C14	.49	74C240	.49
74C32	.45	74C244	1.49
74C74	.49	74C373	1.49
74C85	1.29	74C374	1.49
74C86	.29	74C911	5.95
74C89	1.49	74C912	7.95
74C90	.99	74C915	.69
74C151	.99	74C917	3.95
74C154	2.95	74C920	3.95
74C157	1.49	74C921	2.49
74C160	.25	74C922	3.95
74C161	.25	74C923	3.95
74C162	.25	74C925	4.95
74C173	.25	74C926	5.95

MISC. COMPONENTS

TANTALUM CAPACITORS

TM.1	.1µf @ 35V	.19	TM4.7	4.7µf @ 35V	.45
TM1	1µf @ 35V	.19	TM6.8	6.8µf @ 35V	.59
TM2.2	2.2µf @ 35V	.25	TM10	10µf @ 35V	.69

POTENTIOMETERS

Values available (insert ohms into space marked "XX"): 500Ω, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 500K, 1MEG

43PXX 3/4 Watt,15Turn	**.99**	**63PXX** 1/2 Watt, 1Turn	**.89**

TRANSISTORS AND DIODES

PN2222	.13	PN2907	.13	1N4004	.10
2N2222A	.29	2N4401	.15	1N4148	.07
2N3055	.69	1N270	.25	1N4735	.25
2N3904	.12	1N751	.15	C106B1	.49

SWITCHES

JMT123 SPDT, On-On	1.25	206-8 SPST, 16-pin DIP	1.19
MPC121 SPDT, On-Off-On	1.25	MS102 SPST, Momentary	.39

D-SUB CONNECTORS

DB25P Male, 25-pin	.69	DB25S Female, 25-pin	.75

LEDS

XC209R T1, Red	.15	XC556G T1¾, Green	.17
XC556R T1¾, Red	.13	XC556Y T1¾, Yellow	.17

IC SOCKETS

Low Profile		Wire Wrap (Gold) Level #2	
8LP	.11	8WW	.49
14LP	.12	14WW	.65
16LP	.13	16WW	.69
24LP	.21	24WW	1.19
28LP	.23	28WW	1.39
40LP	.29	40WW	1.89

Soldertail Standard (Gold & Tin) & Header Plug Sockets Also Available

74HC HI-SPEED CMOS

Part No.	Price	Part No.	Price
74HC00	.19	74HC175	.59
74HC02	.19	74HC221	.89
74HC04	.19	74HC240	.69
74HC08	.19	74HC244	.79
74HC10	.19	74HC245	.79
74HC14	.29	74HC253	.25
74HC30	.25	74HC259	.49
74HC32	.25	74HC273	.49
74HC74	.29	74HC373	.69
74HC75	.35	74HC374	.69
74HC76	.35	74HC595	1.29
74HC85	.55	74HC688	1.49
74HC86	.29	74HC943	6.95
74HC123	.59	74HC4040	.79
74HC125	.49	74HC4049	.19
74HC132	.49	74HC4050	.25
74HC138	.45	74HC4060	.69
74HC139	.39	74HC4511	.49
74HC154	1.49	74HC4514	1.79
74HC163	.39	74HC4538	1.19
74HC174	.59	74HC4543	1.19

74HCT-CMOS TTL

74HCT00	.17	74HCT139	.25
74HCT02	.17	74HCT157	.29
74HCT04	.19	74HCT174	.15
74HCT08	.17	74HCT175	.19
74HCT14	.29	74HCT240	.69
74HCT32	.19	74HCT244	.49
74HCT74	.29	74HCT245	.49
74HCT86	.25	74HCT373	.49
74HCT138	.39	74HCT374	.39

LINEAR

Part No.	1-9	10+	Part No.	1-9	10+
TL071CP	.69	.59	DS14C88N	1.19	1.09
TL072CP	.79	.69	LM1489N	.49	.45
TL074CN	.99	.89	DS14C89N	1.19	1.09
TL081CP	.59	.49	LM1496N	.69	.59
TL082CP	.59	.49	LM1871N	1.95	1.75
TL084CN	.99	.89	LM1872N	1.95	1.75
LM307N	.45	.39	ULN2003A	.79	.69
LM308N	.65	.59	ULN2004A	.79	.69
LM309K	1.49	1.25	26LS29	2.95	2.75
LM310N	1.49	1.25	26LS31	1.19	.99
LM311N	.49	.39	26LS32	1.19	.99
LM317T	.69	.59	26LS33	1.75	1.49
LM318N	1.09	.99	ULN2803A	1.19	.99
LM319N	1.29	1.19	LM2901N	.39	.29
LM323K	3.49	3.25	LM2907N	1.29	1.19
LM324N	.39	.35	LM2917N (8 pin)	1.75	1.49
LM335Z	1.49	1.25	MC3470P	1.29	1.19
LM336Z	1.09	.99	MC3479P	3.95	3.75
LM337T	1.29	1.09	MC3486P	1.29	1.19
LM338K	4.49	4.25	MC3487P	1.29	1.19
LM339N	.49	.39	LM3900N	.49	.45
LF347N	1.49	1.25	LM3905N	1.29	1.19
LM348N	.69	.59	LM3909N	.89	.79
LF351N	.49	.39	LM3914N	1.95	1.75
LF353N	.59	.49	NE5532	.89	.79
LF356N	.89	.79	NE5534	.89	.79
LF357N	.99	.89	7805K	1.29	1.19
LM358N	.59	.49	7812K	1.29	1.19
LM380N	.89	.79	7815K	1.29	1.19
LM385Z1.2	1.75	1.49	7805T	.49	.45
LM386N-3	.89	.79	7808T	.49	.45
LM393N	.45	.39	7812T	.49	.45
LF398N	1.95	1.75	7815T	.49	.45
LF411CN	.79	.69	7905K	1.49	1.25
LF412CN	1.29	1.19	7905T	.55	.49
NE555V	.35	.29	75113	1.39	1.19
XRL555	.75	.65	75150	1.29	1.19
LM556N	.49	.39	75154	1.29	1.19
LM565N	.99	.89	75174	2.95	2.75
LM566CN	1.29	1.19	75175	2.95	2.75
LM567V	.75	.65	75176	2.25	1.95
LM723CN	.49	.39	75451	.45	.39
LM741CN	.35	.29	75452	.45	.39
LM747CN	.59	.49	75492	.89	.79
LM1458N	.39	.35	MC145406P	2.95	2.75
LM1488N	.49	.45			

PARTIAL LISTING • OVER 4000 COMPONENTS AND ACCESSORIES IN STOCK! • CALL FOR QUANTITY DISCOUNTS

RAMs ARE SUBJECT TO FREQUENT PRICE CHANGES

Circle 149 on Reader Service Card

PC-LabCard

19″ Rack Mountable Industrial PC

IPC-600

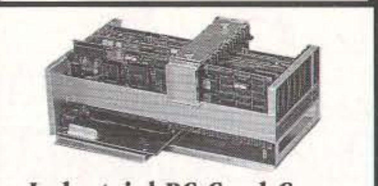
- 19″ Rack mountable chassis
- 12 Slot passive backplane
- Supports 80286 or 80386 CPU card
- Cooling fan with removable air filter
- Special hold-down clamp to protect plug-in cards against vibration
- Shock mounted disk drive housing supports 2 half height drives

For Your Catalog Call 408-293-6786

Advantech

Circle 20 on Reader Service Card

PC-LabCard



Industrial PC Card Cage with 8 Slot Backplane

IPC-6010

- Open-style framework for flexible installation in custom enclosure
- 8 Slot industrial backplane
- 4 Layer PCB with dedicated power & ground planes
- Supports both standard PC power connection and industrial screw terminal connection
- Special hold-down clamp to protect plug-in cards against vibration

For Your Catalog Call 408-293-6786

Advantech

Circle 20 on Reader Service Card

PC-LabCard

RAM/ROM Disk Card for "Diskless" PC

PCL-790

- Replaces mechanical disk drive by solid-state disk
- Interchangeable SRAM or EPROM memory module
- Supports up to 4 cards in a single PC with power-on autoboot capability
- Ideal for high speed, heavy duty access and high reliability applications

ADVANTECH

USA & Canada: contact San Jose,CA
Tel: 408-293-6786 Fax: 408-293-4697
Europe & Asia: contact Taipei, Taiwan
Tel: 886-2-9184567 Fax: 886-2-9184566

Advantech

Circle 20 on Reader Service Card

ALL NEW !!!
9 TRACK TAPE SUBSYSTEM
for IBM PC/AT/386
complete for only
$2,595.00
1 YEAR WARRANTY

- **IBM/ANSI** compatible at 800*/1600/3200 bpi
- Controller, cables and software included
- Interfaces for PS/2*, Xenix* and DEC*
- SCSI*, AT or MCA* Bus I/O at 25/50/100 ips.

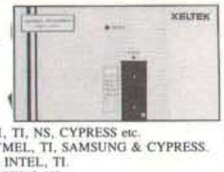
* optional

AKSystems Inc.
20741 Marilla St. Chatsworth CA 91311
TEL:818/709-8100 FAX: 818/407-5889

Circle 14 on Reader Service Card

UNIVERSAL PROGRAMMER

$585 including: S/W cable, interface card, 1 yr. warranty. 30 day money back guarantee.



Programs:
- E(E)PROMs upto 2MBits & 16 Bit wide.
- PALs from AMD, MMI, TI, NS, CYPRESS etc.
- 22 V10 from AMD, ATMEL, TI, SAMSUNG & CYPRESS.
- EPLDs from ALTERA, INTEL, TI.
- GALs from LATTICE, SGS & NS.
- FPLs from SIGNETICS.
- PEELs from ICT, HYUNDAI & GOULD.
- BIPOLAR PROMs.
- SINGLE CHIPs (8748, 8751 & 87C51 series).

Supports:
- 32-Bit WORDSPLIT with 4 GANG adaptor.
- PALASM2/CUPL/ABEL/TANGO/OrCAD JEDEC files.
- PAL VERIFICATION using TEST VECTOR.
- GAL electronic signature recognition.
- 32-Bit WORDSPLIT with 4 GANG adaptor.
- 87C451, 63701X/Y/V & 63705V with adaptor.
- Test ICs (TTL, CMOS) & D/S Memorys, ICs with user definable test patterns.

High speed, parallel interface & S/W upgradable for new parts.

XELTEK
473 SAPENA CT. #26
SANTA CLARA, CA 95054

1-800-541-1975 (Toll Free Order)
TEL: (408) 727-6995
FAX: (408) 727-6996
COD,VISA,MC,AMEX

Circle 299 on Reader Service Card

FREE CATALOG

RS-232C INTERFACE & MONITORING EQUIPMENT CATALOG

WRITE or CALL for YOUR FREE COMPREHENSIVE B & B ELECTRONICS CATALOG TODAY! Pages and pages of photographs and illustrated, descriptive text for B&B's complete line of RS-232 converters, RS-422 converters, current loop converters, adapters, break-out boxes, data switches, data splitters, short haul modems, surge protectors, and much, much more. Most products meet FCC Part 15J. Your RS-232 needs for quality, service and competitive prices will be more than met by B&B ELECTRONICS. **Manufacturer to *you*, no middleman!** Money-back guarantee! Same-day shipment! One-year warranty on products! Technical support is available.

Order direct from manufacturer TODAY & SAVE!

Write For Your FREE Catalog Today!

B&B electronics MANUFACTURING COMPANY
4002D Baker Road, P.O. Box 1040 • Ottawa, IL 61350
Phone: 815-434-0846

Circle 37 on Reader Service Card

33 MHz 80386 Motherboard

Faster than the Everex Step™
8.3 MIPS! $2,099 (0k) Qty 1

Features:
- 64K/256K Write Back Cache
- Dual Read/Write Cache
- 100% Faster DMA Throughput than Standard AT
- Transparent Refresh
- True 32-Bit Memory Exp. to 16MB
- Support 80387/Weitek
- UNIX, OS/2 & Novell Compatible
- 1 Year Full Warranty
- Complete Documentation

	MIPS	Cache	0k	4M
386/33	8.3	256K	2499	2949
386/33	8.3	64K	2099	2549
386/25	6.2	64K	1399	1799
386/20	4.9	64K	1199	1599

Technology Power Enterprise, Inc.
46560 Fremont Blvd #118, Fremont CA 94538
Tel (415) 623-9162 FAX (415) 623-9462

Circle 279 on Reader Service Card

8051 68HC11 EMULATORS

For info call:

Australia	(02) 654 1873
Austria	(0222) 38 76 38
Benelux	+31 1858-16133
Denmark	(02) 65 81 11
Finland	90-452 1255
France	(01) 69 412 801
Great Britain	0962-73 3140
Israel	(03) 484832
Italy	(011) 7710010
Korea	(02) 784 7841
New Zealand	(09) 392464
Portugal	(01) 83 56 70
Scandinavia	+46 40922425
Singapore	065 743-2086
Spain	(93) 217 2340
Switzerland	(01) 740 41 05
Taiwan	(02) 7640215
Thailand	(02) 281-9596
West Germany	08131-1687
U.S.A. FAX	(408) 378-7869

NOHAU CORPORATION
51 E. Campbell Ave. • Campbell, CA 95008
(408) 866-1820

Circle 205 on Reader Service Card

DYNAMIC RAMS

SIMM	80/100	$CALL
1MBIT	100ns	$ 7.95
514256	100ns	$ 8.50
41464	150ns	$ 2.65
41256	100ns	$ 2.55
✓ 41256	120ns	$ 2.40
51258	80ns	$ 3.75
✓ 4164	120ns	$ 2.10

* For high-speed, Zip, Plcc, Simm .... Please Call !

MATH COPROCESSORS

80387-33	33mHz	$550.00
80387-25	25mHz	$445.00
80387-20	20mHz	$355.00
80387-16	16mHz	$305.00
80387SX	16mHz	$290.00
80C287A	12mHz	$265.00
80287-10	10mHz	$208.00
80287-8	8mHz	$185.00
8087-1	10mHz	$160.00
8087-2	8mHz	$125.00

E PROMS

27C101	250ns	$ 17.00
27C512	200ns	$ 9.75
27512	250ns	$ 7.75
27C256	250ns	$ 5.25
27256	250ns	$ 4.25
27128A	250ns	$ 4.00
27C64A	200ns	$ 4.25
2764	250ns	$ 3.50

CPU

V-30	8mHz	$ 12.75
V-20	8/10mHz	$ 8.5/15

I.C. EXPRESS

15140 Valley Blvd. City of Industry,CA 91744
Customer service: (818) 333-8880 FAX: (818) 369-1236

ORDER: (800) 877-8188 (Mon.-Fri. 8-5 PST)
CALL FOR CURRENT PRICES & VOLUME DISCOUNTS.

Price Shown for cash. MasterCard/Visa add 3%. Prices are subject to change. Minimum order $10.00. Shipping & Handling: UPS Ground $5.00, Air $7.00 (1 lb.)
ALL MERCHANDISE IS 100% GUARANTEED WITH PROMPT DELIVERY.

Circle 148 on Reader Service Card

HELP
THE AMERICAN FOUNDATION FOR THE BLIND
HELP YOU!

The American Foundation for the Blind's National Technology Center (NTC) maintains a Job Index/User Network which features information from over 1,100 blind and visually impaired people who use adaptive equipment in a variety of jobs.

The NTC is looking for additional participants. Blind and visually impaired individuals of all ages who have hands-on experience with computers, low vision aids, talking products, or other adaptive devices are needed as resource people and/or evaluators.

As a resource person, other users may contact you to share your knowledge and experience. As an evaluator, you may be asked to evaluate both existing and newly developed or adapted devices. Evaluations are published in the "Random Access" section of the *Journal of Visual Impairment & Blindness.*

If you are interested, please fill out the form below or call our hotline, 1-800-232-5463 (New York residents call 212-620-2147). Tell the operator you wish to be part of the Job Index/User Network.

Your response will be followed by a brief, confidential telephone survey. The information you provide will be used for NTC purposes only and will include the equipment you use, your experience with it, training and employment.

Your assistance will enable the Job Index/User Network to continue as a major information and support system for blind and visually impaired people nationwide.

Mail to: American Foundation for the Blind, National Technology Center, 15 West 16th Street, New York, NY 10011, Attn: A. Hypolite

Name ______________________________

Address ______________________________

City ____________ State ____________ Zip ____________

Best time to contact ____________ Telephone ____________

COMPUTER DISCOUNT WAREHOUSE™

CD-ROM

HITACHI 3600/3650 $589.77
NEC External 559.10
NEC Internal 499.55
NEC XT / AT / PS/2 138.93
TOSHIBA CD-ROM External 799.29
TOSHIBA CD-ROM PS/2 External 1069.12

IRWIN 145C 40MB Internal $339.94
IRWIN 2080 80MB Internal PS/2 442.70
IRWIN 445 AT 40MB External 472.27
IRWIN 745SP 40MB External 499.98
IRWIN 785SP 80MB External 567.05
IRWIN 485A 80MB External AT 538.64
IRWIN 6451E 250MB External 1077.86
IRWIN 787SP 120MB Internal 592.77

WHY PAY RETAIL?

CDW™ Sells For Less

AND **SERVICES** YOU BETTER

INTEL BOARDS & CO-PROCESSORS

INTEL Above Board Plus $399.68
INTEL Inboard 386/PC 569.53
INTEL Visual Edge 448.39
INTEL Connection Co-processor 495.67

SPEED UP YOUR PC UP TO 500%!

MATH COPROCESSORS

INTEL 80287-8 $206.55
INTEL 80287-10 223.55
INTEL 80387-16 337.60
INTEL 80387-20 390.65
INTEL 80387-25 478.92
INTEL 80387-SX 299.82
INTEL 80387-33 575.20
INTEL 80C287-A 268.50

INTEL 8087-2 $119.90
INTEL 8087-3 95.20
INTEL 80287-6 137.30

HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

COMPUTERS

SAMSUNG

S-3000VE, 4.77/10 MHz $499.11
S-550 AT Comp., 8/12 MHz 885.64
S-550, 20 Meg 1198.80
SD700SX CALL
SAMSUNG PC TerminalL/286 835.60
S-630 - 286 693.50

PACKARD BELL

PB 686, 12 MHz $717.80
PB 286, 20 Meg Laptop / 40 Meg Laptop 1937.55 / 2134.37
PB 386/25 2519.20
FORCE 386SX, 16 MHz 1273.70
FORCE 386SX, 40 Meg 1595.13

TOSHIBA

T-1000SE CALL | T5200, 40 Meg TOSHIBA
T1600 CDW™ | T3100e PRICES!
T1200, 2 Drive FOR | T5200, 100 Meg ALL
T5100 THE | T3100SX MODELS
T1200, 20 Meg LATEST | T3200SX AVAILABLE

WYSE

MDL 3216 $998.17 | MDL 2116 $1138.20
MDL 3225 3476.22

IBM PS/2

30286, 30 Meg 1845.55 | MDL 55SX, 60 Meg 3178.39
MDL 70, 60 Meg 3747.20 | MDL 55SX, 30 Meg 2899.59
MDL 30286, 1 Dr. 1412.10 | MDL 30286, 20 M 1710.50
MDL 7361 Port 5449.75 | MDL 80, 70 Meg 5069.37

COMPAQ

286, MDL 1 $1549.95 | 386S84 $3280.40
286E, MDL 1 1899.50 | 386, 25MHz, Md300 8177.99
386-20E, 100 Meg 4911.22 | 386-20E, 40 Meg 4298.12
386S, MDL 1 2324.49 | LTE Laptops CALL

HEADSTART

Headstart III LX CD Unit NEW MODEL
Headstart III CD Unit TOO LOW
Headstart XT Explorer TO ADVERTISE

HP & CPQ COMP. MEMORY

1MB Module CPQ - 386,386S, 20E $189.66
4MB Module CPQ - 386, 386S, 20E 593.50
1MB Exp. Bd. - 386S, 20E 198.86
4MB Exp. Bd. - 386S, 20E 638.70
2MB Upgrade LaserJet II / IID 317.36
2MB Upgrade LaserJet IIP 346.13
4MB Upgrade LaserJet II / IID 545.87
4MB Upgrade LaserJet IIP 219.65

WYSE TERMINALS

WYSE 50/60 Amber or Green $373.40 / 300.16
WYSE 85 / 30 Amber 375.90 / 294.10
WYSE 99GT / WYSE 150 394.82 / 272.45

PLOTTERS, DIGITIZERS & SCANNERS

CalComp

1023 $3498.40 | 12 x 12 $358.12
1043DM 5825.15 | 12 x 18 719.10
1025 4544.06 | 36 x 48 3236.15

KURTA

1212IS1 $349.06 | 36 x 48 $2891.53
12 x 17 499.35 | 4 Button Cursor 75.00

LOGITECH

Scanman PC / Scanman PS/2 $177.89 / $214.50
Trackman 93.00

Summagraphics

Summa II 12 x 12 $367.40
Summa II 12 x 18 $599.50

HEWLETT PACKARD

HP7440A $968.30
HP7475A 1389.89
HP7550 2926.56
HP7570 LOWEST PRICE
HP7576-EXL CALL
HP SCANJET + 1049.66

HOUSTON INSTRUMENT

HI DMP-52
DMP-52MP
HI DMP-61DL
DMP62DL
Image Maker/Jetpro

PRINTERS

EPSON

LX810 CALL | LQ510 ALL EPSON
LQ850 CDW™ | LQ950 MODELS
FX850 FOR BEST | LQ1050 READY
FX1050 PRICE | LQ2550 TO SHIP
LQ1010 EVER | CALL FOR ACCESSORIES
CDW™ stocks all cut sheet feeders and ribbons.

NEC

P2200XE $344.65 | P5300 $685.63
P5200 509.12 | P960XL 1039.24

DICONIX by KODAK

150P /300 $309.17 / 418.17

TOSHIBA

Expresswriter 311 CDW™ | 321SL MODELS
Expresswriter 301 HAS | 341SL IN STOCK
351SX ALL TOSHIBA | CALL FOR PRICES

brother

M-1809 $363.63 | M-1909 $457.10
M-1824L 482.95 | M-1924L 599.65

OKIDATA

ML 182 Turbo $234.48 | ML 321 $479.28
ML 172 199.95 | ML 390 475.96
ML 380 357.95 | ML 391 639.48
LASER 400 930.00 | ML 393 995.90
ML320 329.68 | ML 393 Color 1067.60

Panasonic

1124 $292.75 | 1592 $409.44
1695 CALL | 1191 232.12
1180 193.95 | 1624 445.32

LASER PRINTERS

BROTHER HL-8e / Postscript $1799.90 / 3277.20
H-P LaserJet Model 2 / IID 1575.95 / 2744.95
H-P Deskjet Plus/H-P Laserjet IIP 679.33/1034.07
H-P Laserjet III CALL
H-P Deskwriter 819.22
NEC LC890 3095.60
PACIFIC DATA 25 in 1 Cartridge 272.86
PACIFIC DATA Postscript Cartridge 478.60
PACIFIC DATA Plotter in a Cartridge 247.50
PACIFIC DATA 1 Meg Upgrade 229.39
PACIFIC DATA 1 Meg for 2P 252.94
PACIFIC DATA Headliner 268.28
TOSHIBA Page Laser 12 CALL

#1
- Sales
- Services/Support
- Product Knowledge
- On Time Delivery
- Frequent Buyers Program

DRIVES, TAPES & CARDS

CONNER 40 Meg / 110 Meg $409.29 / 627.29
IOMEGA 20+20 External 8" 1658.92
IOMEGA B1441/B144X 998.65 / 1299.10
IOMEGA B244X/B120X 1990.25 / 992.80
IOMEGA B220X, External 5.25" 1619.40
MOUNTAIN 4440 Int. / Ext. 385.80 / 557.75
MOUNTAIN 150M Filesafe 1398.39
MOUNTAIN 300 Meg External 2538.80
MOUNTAIN 2.2 Gigabyte 4453.30
PLUS Passport 40 / 40 System Kit 489.75 / 579.86
PLUS PS/2 MC System Kit 585.58
PLUS DEVELOPMENT 20 Meg/40 Meg $498.44/567.80
STORAGE DIMENSION ALL MODELS CALL
SYSGEN 5.25" External Floppy 225.25
WELTEC 5.25" External Floppy 207.77

Seagate

SEAGATE 20 Meg $259.58 | SEAGATE 4096 80 559.95
SEAGATE 30 Meg 269.32 | SEAGATE ST-251-1 325.23
ST4383E 329 MB 1588.10 | ST4766E 676 MB 2452.40
ST4182E 160 MB 1098.44 | ST1126A 111 MB 710.68
ST1162A 143 MB 919.44 | ST2383A 338 MB 1864.40

MICROPOLIS

1335 70 Meg $565.40 | 1355 142 Meg $1050.40
1375 153 Meg 1469.85 | 1558 338 Meg 1512.52

NOVELL NETWORKING

SOFTWARE STARTER KITS

Entry-Level 286 Starter Kit, 4 Users CALL
Entry-Level 286 Starter Kit, 8 Users FOR BEST
NOVELL Netware 386 NOVELL
NOVELL 286 Advanced Netware V. 2.15 PRICING
NOVELL SFT Netware V. 2.15 AUTHORIZED
NOVELL Netware Assurance SALES & SERVICE

INTERFACE CARDS

3COM ETHERLINK $375.45
ARCNET PC110 LANboard PS/2 343.75
ARCNET PC130 LANboard 164.27
ARCNET PC130E LANboard 189.50
ARCNET SMC 16-Bit File Server Board 393.50
ARCNET SMC 16-Bit Workstation Board 276.15
ETHERNET Interface Connector (NE1000) 156.25
G-NET Interface Card w/Cable 298.52
NOVELL NE2000 209.40
THOMAS CONRAD 16 Port Hub 699.25
THOMAS CONRAD 8 Port Hub 378.65

MODEMS & COMMUNICATIONS

intel

INTEL 2400 Internal/External 149.75/176.94
INTEL 2400B MNP 2400 Ext. MNP 191.22/224.11

PRACTICAL PERIPHERALS

2400MNP Int. $169.11 | 2400 Int. $128.88
2400SA MNP 197.72 | 2400SA 172.97

HAYES

1200 External $278.60 | 2400B Internal $224.45
1200B Internal 163.20 | 2400 PS/2 345.40
2400 External 338.84

USRobotics

Courier 1200 $189.60 | 1200 External $129.10
Courier 2400 279.60 | 2400B 199.70
1200B 108.45 | 14,400 HST 586.75
Dual 14,400 HST 952.65

MHz MEGAHERTZ CORPORATION

2400 for ZENITH $167.10 | 1200 for COMPAQ SLT $259.80
2400 for NEC 225.88 | 2400 for TOSHIBA 183.74

BATTERY BACKUP & SURGE

AMERICAN

AME-1200VX $911.45 | AME-520ES $377.48
AME-330XT 257.72 | AME-800RT 699.19
AME-450AT 321.82

DataShield

500 Watt $555.05 | SS700+ $887.90
800 Watt 628.56 | 1200 Watt 962.75
S100 59.55 | 6 Outlet Surge 27.85

Durant Technologies, Inc.

BPS-300 $314.00 | BPS-550 $474.11
BPS-500 465.88 | BPS-1200 698.82
BPS-800 648.30

TRIPP LITE

BC-450 $349.50 | 4 Outlet $44.25
BC-1200 649.55 | LC-1200 158.85
BC-2000 1179.80 | LC-1800 196.80

MISC & ACCESSORIES

A-B Switching Box /ABX Box) $39.95/ 44.95
BASF 5 Pack of 10 DS/DD w/Case 29.00
INTELLICOM Long Link 129.70
KENSINGTON Masterpiece/Plus 99.99/123.40
KEYTRONICS 5151 IBM or AT&T 133.95
KEYTRONICS 101 94.95
5TH GEN. Logical Connection 256K / 512K 447.72 / 514.36
Electronic 4-Way Switchbox 99.85
XT Power Supply 150 Watt 59.00

FAX MACHINES AND BOARDS

CompleteFax 9600 $399.50 | SHARP FO-330 $995.00
JT-Fax 9600 527.65 | OKI Fax Machines CALL

SOFTWARE

WORDPERFECT 5.1 5.25" or 3.5" $246.39
ASHTON TATE dBase III+ / dBase IV 424.00 / 476.10
ASHTON TATE Multimate Advantage II 288.12
LOTUS 1-2-3 5/25" / 3.5" V2.2 339.95
LOTUS 1-2-3 V.3 / LOTUS Networker 337.00 / 1592.20
BORLAND Paradox 3.0 439.17
BORLAND Quattro / Quattro Pro 94.52 / NEW
BORLAND Sidekick Plus 131.25
MICROSOFT Excel / Windows 386 299.04 / 129.05
LAN Spool / LAN Space 265.10 /319.00
MERIDIAN Carbon Copy 119.37
SYMANTEC Q&A 217.40
SOFTWARE PUB. Harvard Graphics 274.71
XEROX Ventura Software Version 2.0 489.00

MONO MONITORS & CARDS

CDW™ Color / Mono Cards w/P $84.00 / 79.00
HERCULES™ Color / Mono Cards w/P 146.14 / 179.84
AMDEK 410A / 1280 149.99 / 679.78
COMPAQ Mono / VGA Mono 167.00 / 209.95
IBM PS/2 8503 209.95
SAMSUNG Amber 84.10
PACKARD BELL 1472 Amber or White 124.35
PGS MAX 12E / MAX 15 139.40 / 258.20
PACKARD BELL Green or Amber 89.95

COLOR GRAPHIC MONITORS

IBM PS/2 8512 / 8513 $449.40/540.20
SAMSUNG RGB Color 219.36
MAGNAVOX 8762 259.05

VGA & EGA PRODUCTS

VGA & EGA MONITORS

COMPAQ VGA Monitor $499.68
MAGNAVOX 943EGA 365.40
MAGNAVOX 9CM062 372.52
MITSUBISHI 1410 360.50
MITSUBISHI 1381 Diamond Scan 499.80
NEC Multisync 4D/5D 1183.36 / 2337.75
NEC Multisync XL 19-Inch 1778.40
NEC Multisync 2A / Multisync 3D 494.85 / 599.85
PACKARD BELL 8541 VGA 319.20
PACKARD BELL 8531 359.70
PACKARD BELL 8530 383.80
PGS Ultrasync 12 493.33
PGS Ultrasync 14 / 16 499.66 / 887.77
SAMSUNG VGA 392.50
SONY Multiscan 1302 / 1304 619.95 / 660.52
ZENITH Z-1492 594.80

VGA DISPLAY CARDS

ATI VGA Wonder 256 / 512 $262.98 / 327.84
GENOA 6100 144.76
GENOA 6300 / 6600 157.26 / 309.85
PARADISE 1024i 272.10
PARADISE VGA / VGA + 16 168.70 / 204.30
VIDEO 7 1024i 272.10
VIDEO 7 VRAM VGA 405.25

EGA DISPLAY CARDS

PARADISE Auto Switch EGA 480 $104.70
VIDEO 7 Vega Deluxe 187.05

CAD MONITORS & CARDS

MITSUBISHI 6905, 19-Inch $2063.90
MITSUBISHI 6605 CALL
MITSUBISHI 3905AOK 1798.80
SIGMA Laserview 1687.18
VERMONT Cobra 2777.75
METHEUS 1104 1039.00

MICE

LOGITECH C9 Serial /PS/2 $99.95
LOGITECH BUS 94.99
MICROSOFT Mouse (Bus Version) 109.34
MICROSOFT Mouse (Serial Version) 117.25
MICROSOFT Mouse w/Windows 138.37
MOUSE SYSTEMS (Serial Version) 99.55
MOUSE SYSTEMS (Bus Version) 108.77

MOST ORDERS RECEIVED BY 5:00 P.M. C.S.T. SHIP SAME DAY

HIGH VOLUME BIDS INVITED
2840 MARIA NORTHBROOK IL 60062 FAX (708) 291-1737

PC Magazine says..."You may find a better deal here than anywhere else."

WHY WAIT? CALL COMPUTER DISCOUNT WAREHOUSE™ NOW!

E40

WE SELL NAME BRAND ITEMS FOR LESS!

CDW™ EXTENDED HOURS
Sales 7:30-7:30 CST Mon-Fri.
9:00-3:30 CST Sat.
Tech Support 9:00-5:00 CST Mon-Fri.

(800) 233-4426

In Illinois (708) 498-1426 | FAX (708) 291-1737

Credit card charges are not submitted until time of shipment.

MEMBER MMC MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.

PC WEEK CORPORATE SERVICE CODE MEMBER

Apply for the CDW™ Credit Card

Credit Card charges are not submitted until time of shipment. Shipping and handling additional. On all hard drive orders under $200.00 please add $5.00 handling fee. Non-defective returns subject to restocking fee. All prices reflect 3% discount for cash. Allow 10 business days for shipping when paying by personal check. Software, chips and other electronic components are not returnable. All pricing subject to change. ™ - Registered trademarks of IBM and COMPAQ.

Circle 64 on Reader Service Card

90 KHZ 4-CHANNEL SIMULTANEOUS SAMPLE / HOLD WITH 12-BIT RESOLUTION

SINGLE PIECE PRICE $995

- For IBM PC/XT/AT® and compatibles
- 32K data buffer
- Pre-trigger or post-trigger data or any combination of both
- Stream data to disk
- Two 4-bit optically isolated output ports
- Event marker and auxiliary inputs
- Flexible and expandable

LAWSON LABS, INC.
5700 Raibe Road
Columbia Falls, MT 59912
406-387-5355
800-321-5355

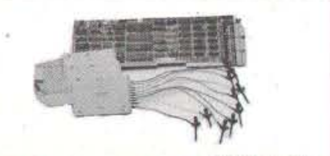
Circle 165 on Reader Service Card

almost UNIVERSAL PROGRAMMER

PAL
GAL
EPROM
EEPROM
PROM
87xxx... **$475**

LATTICE-MMI-CYPRESS-INTEL-TI-AMD-ALTERA-NS...

200/100 MHz Logic Analyzer



$1299-LA27100(100 MHz)
$1899-LA27200(200 MHz)
Price is complete Pods and Software included

• FREE software updates on BBS

Call - (201) 994-6669
Link Computer Graphics, Inc.
4 Sparrow Dr., Livingston, NJ 07039
FAX:(201)994-0730

Circle 166 on Reader Service Card

ULTRA:BASE
COMPLETELY USER FRIENDLY

BRANDYWARE presents ULTRA:BASE

Finally a database you can use without timely manuals, and have fun doing it! Features include, Help windows, Mailing labels, Calculator, Memo pad & alarm, Faskeys, Amortization, Up to twenty numeric fields, Scan twenty records at a time, Snapshots of the complete record to the printer, Global update and delete, Auto-date, Grand totals, Running totals, List of matching records, Auto fill-in of all deleted records, and records the last time the folder was used.

Plus all the standard features like searching, updating, sorting, dos shell, printing records to the printer or screen, printing results of amortization to printer or screen, rename fields or folders, delete folders, All this and NO manual required. All the help you need is provided for you, at the time you need it, with on screen help and pop-up help windows. Guaranteed to be the easiest database (with power) to use, or your money back.

requires CGA, EGA, VGA, Hard drive
Send check or money order to:

BRANDYWARE
24 North Hibbert suite 6
Mesa, Arizona 85201
602-644-1067

ONLY **$79.95**

C.O.D. OK

Circle 52 on Reader Service Card

Remote POWERONOFF

PHONE CONTROL

- LC-89 *POWEROFF* $189
- LC-90 *POWEROFF+* $210
- LC-91 *POWERONOFF* $279

plus $6.00 shipping and handling

The perfect compliment to your external modem and PC; providing everything you need to access your computer from any remote site, **even if it isn't on.** Also included at the low price of $279 is **"pcAnywhere"**, the award winning communications software. So **there is nothing else to buy,** making the **LC-91** a truly outstanding value. All models allow you to ***POWEROFF*** your system under keyboard or software command, or after any number of unattended applications.

* MAKING PRODUCTIVITY CONVENIENT *

30 DAY MONEY BACK GUARANTEE
FULL (2) YEAR WARRANTY
(Made in USA, Patent Pending)

L-Tech
9205 South Keating
Oak Lawn, IL 60453
FAX: (708) 423 - 5369

CALL: 1-800-342-5196

Circle 173 on Reader Service Card (DEALERS: 174)

8031 In-Circuit Emulation $199

Our emulator provides most of the features of an 8031 In-Circuit-Emulator at a significantly lower price. It assists in integration, debug, and test phases of development. Commands include: disassembly, trace, breakpoint, alter register/memory, and load Intel Hex file.

HTE
HiTech Equipment Corp
9400 Activity Road
San Diego, CA 92126
(619) 566-1892

Circle 138 on Reader Service Card

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for FEB. 18, 1990

OUTSIDE OKLAHOMA: NO SALES TAX

DYNAMIC RAM			
1MB SIMM	MEM DeskPro 386/20		$295.00
SIMM	AST Prem386/33Mhz		225.00
SIMM	1Mx9	80 ns	92.00
SIMM	256Kx9	100 ns	35.00
1Mbit	1Mx1	80 ns	8.75
41256	256Kx1	60 ns	4.15
41256	256Kx1	80 ns	2.50
41256	256Kx1	100 ns	2.20
41256	256Kx1	120 ns	1.95
4464	64Kx4	120 ns	2.50
41264*	64Kx4	100 ns	7.50
EPROM			
27C1000	128Kx8	200 ns	$18.00
27512	64Kx8	200 ns	7.80
27256	32Kx8	150 ns	6.50
27128	16Kx8	250 ns	3.75
STATIC RAM			
62256P-10	32Kx8	100 ns	$10.00
6264P-12	8Kx8	120 ns	4.50
6116AP-12	2Kx8	120 ns	4.25

IIT 2C87-20 $325.00
IIT 2C87-12 $295.00
IIT 2C87-10 $260.00

* 2-PORT VIDEO RAM

80387-25 80387-33
80387-16 80387-20
80287-8 $210.00
8087-2 $110.00

OPEN 6 DAYS, 7:30 AM-10 PM: SHIP VIA FED-EX ON SAT.

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY:
Th: S-2 $6.25/4 lb
Fr: P-1 $16.50/1 lb

MasterCard/VISA or UPS CASH COD
MICROPROCESSORS UNLIMITED, INC.
24,000 S. Peoria Ave.,
BEGGS, OK. 74421
(918) 267-4961
No minimum order. Please note: prices subject to change! Shipping, insurance extra, up to $1 for packing materials.

Circle 187 on Reader Service Card

Circle 94 on Reader Service Card (DEALERS: 95)

3M DISKETTES

DS-DD	Quantity Discounts Available	DS-HD
5.39	5.25" 3M Brand Diskettes	10.95
9.59	3.50" 3M Brand Diskettes	19.95
17.95	8.00" 3M Brand Diskettes	20.75

3M DATA CARTRIDGES

DC-2000	14.49	DC-600A	19.99
DC-300XLP	17.99	DC-6150XTD	21.49

3M COMPUTER TAPES

1200' w/tape seal	8.95	DEC TK-50	25.95
2400' w/tape seal	11.95	DEC TK-52/TK-70	39.95
3600' w/tape seal	18.95	IBM-3480	4.95

3M HIGHLAND DISKETTES

3.79	5.25" 3M Brand Diskettes	6.89

3M ACCESSORIES

5¼-Head clean kit	3.95	3M Flip'N'File-5¼	3.95
3½-Head clean kit	10.95	3M Flip'N'File ... 3½	2.95
Plotter Pens/pk 5	5.95	3M Diskcover/50-5¼	7.95
3480 Cleaning Cart	15.95	3M DataSaver-5¼	3.95

BASF INCREDIBLE VALUE!!

DS-DD	Quantity Discounts Available	DS-HD
4.49	5.25" BASF Brand Diskettes	7.79
7.99	3.50" BASF Brand Diskettes	17.95

.32 BASF 5.25" DS-DD No-Logo Bulk with Tyvek sleeves, labels & W/P tabs

2400' w/tape seal	10.95	600' w/tape seal	6.95
1200' w/tape seal	7.95	300' w/tape seal	5.45

maxell *Free 11th Disk with Game

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
5.95*	10.95*	9.69	19.95

Verbatim DataLifePlus Teflon/Preformatted

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
5.95*	10.95	9.69	19.95

Dysan 100% BETTER

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
6.09	10.95	9.69	19.95

KAO Color Diskettes

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.38*	.68*	.69	1.49

*WITH SLEEVES, LABELS AND W/P TABS

No-Logo Bulk Diskettes

5.25" DS/DD	5.25" DS/HD	3.50" DS/DD	3.50" DS/HD
.25*	.49*	.49	1.49*

*WITH SLEEVES, LABELS AND W/P TABS

PRINTER RIBBONS		STORAGE BOXES	
Apple Imagewriter	2.95	Disk File/60-5¼	5.95
Brother HR/15/25	4.95	Disk File/50-3½	5.95
Citizen LSP 120D	3.95	MP-10-5¼	1.50
Diablo HyType II	3.25	MP-10-3½	1.50
Epson MX/FX/RX100	3.55	White Box/10-5¼	.29
IBM Proprinter	3.95	White Box/10-3½	.29
Call for other ribbons		Call for other storage boxes	

TERMS: No surcharge on VISA, Mastercard or AMEX. Order packaging and processing = $2.95 per order. COD orders add $3.95. **SHIPPING:** $1.95/5 cartridges; $0.95/50 diskettes. PO's accepted from recognized institutions on Net 30. Bank Draft, T/T or L/C acceptable. Price quoted for case (100 disks or 10 cartridges). For quantities less than 1 case add 5%.

Toll Free Order Line: 1-800-523-9681
TLX-9102404712
Information Line: 1-801-255-0080
FAX-801-572-3327

DISKCOTECH
DISKCO TECHNOLOGIES, INC.
213 Cottage Avenue
P.O. Box 1339 Sandy, Utah 84091

BACK ISSUES FOR SALE

BYTE

Limited Quantities — Order Now!

	1987	1988	1989	1990
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
Inside the IBM PCs				

Available Issues ☐

Rates (postage and handling included):

1987–'90 BYTE Issues **$6.00***
BYTE '83–'84 Index **$4.00**
BYTE 1985 Index **$4.00**
BYTE 1988 Index **$4.00**
1985 Inside the IBM PCs **$4.00**
1986 Inside the IBM PCs **$5.00**
1988 Inside the IBM PCs **$6.00**
1989 Inside the IBM PCs **$6.00**

*June 1988 (Benchmarks) **$3.00**
*December 1988 **$3.00**

The above prices include postage in the U.S. Please add $.50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries (surface delivery). European customers please refer to Back Issue order form in International Advertising section of book.

Please indicate which issues you would like by checking (√) the boxes.

Send requests with payments to:

BYTE Back Issues
One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281

☐ Check enclosed. Payments from foreign countries must be made in U.S. funds payable at a U.S. bank.

Charge: ☐ VISA ☐ MasterCard

Name ____________________

Card # ____________________

Address ____________________

Exp. Date ____________________

City ____________ State ________ Zip ________

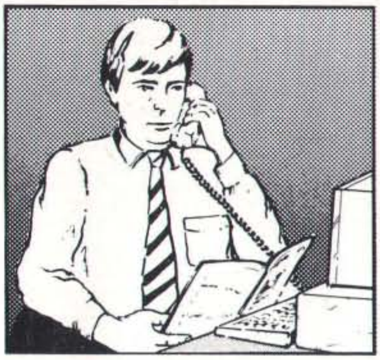
Signature ____________________

All orders must be prepaid. Please allow four weeks for delivery.

Circle 180 on Reader Service Card

Buy with

Confidence



In an effort to make your telephone purchasing a more successful and pleasurable activity, The Microcomputer Marketing Council of the Direct Marketing Association, Inc. offers this advice, "A knowledgeable buyer will be a successful buyer." These are specific facts you should know about the prospective seller before placing an order:

Ask These Important Questions

- *How long has the company been in business?*
- *Does the company offer technical assistance?*
- *Is there a service facility?*
- *Are manufacturer's warranties handled through the company?*
- *Does the seller have formal return and refund policies?*
- *Is there an additional charge for use of credit cards?*
- *Are credit card charges held until time of shipment?*
- *What are shipping costs for items ordered?*

Reputable computer dealers will answer all these questions to your satisfaction. Don't settle for less when buying your computer hardware, software, peripherals and supplies.

Purchasing Guidelines

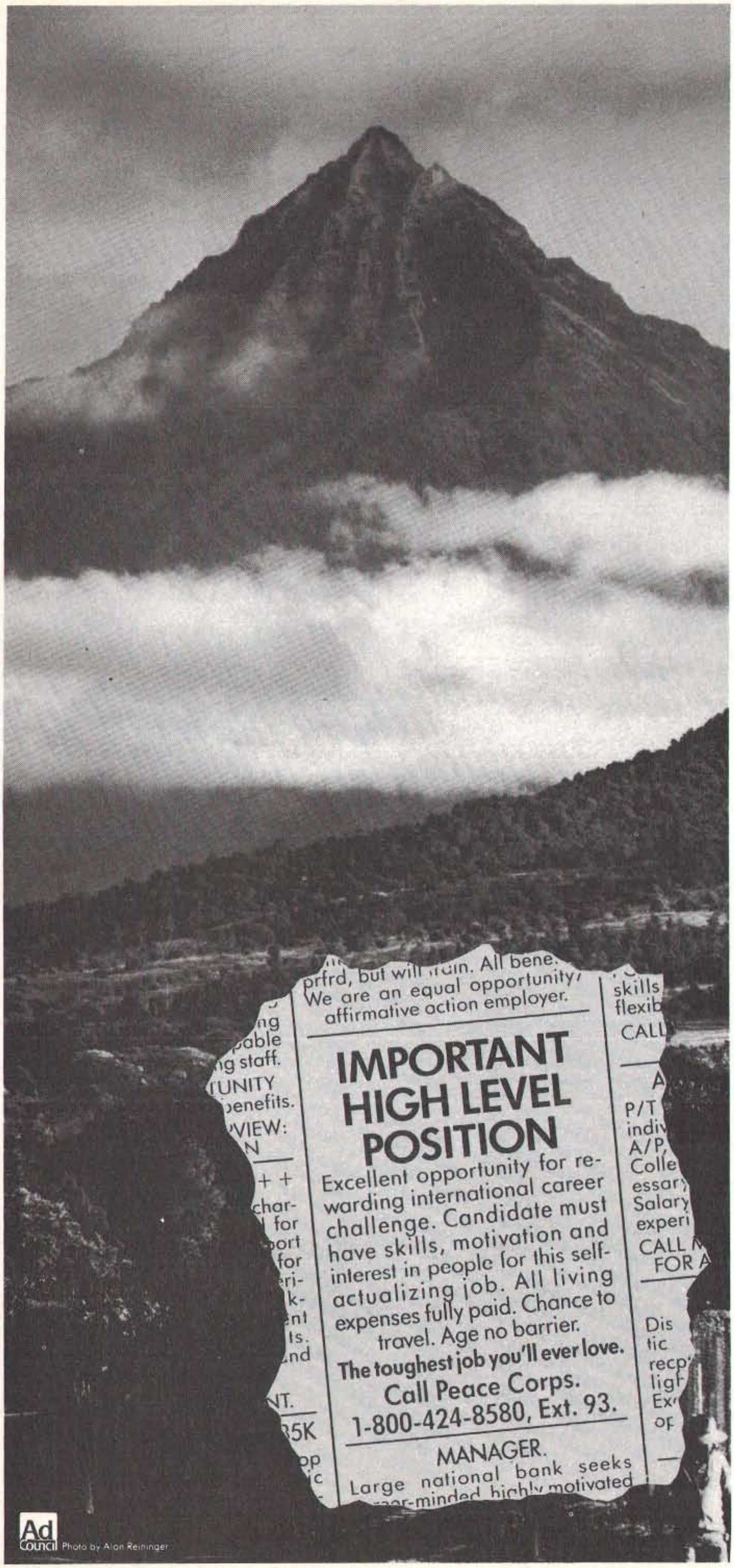
- *State as completely and accurately as you can what merchandise you want including brand name, model number, catalog number.*
- *Establish that the item is in stock and confirm shipping date.*
- *Confirm that the price is as advertised.*
- *Obtain an order number and identification of the sales representative.*
- *Make a record of your order, noting exact price including shipping, date of order, promised shipping date and order number.*

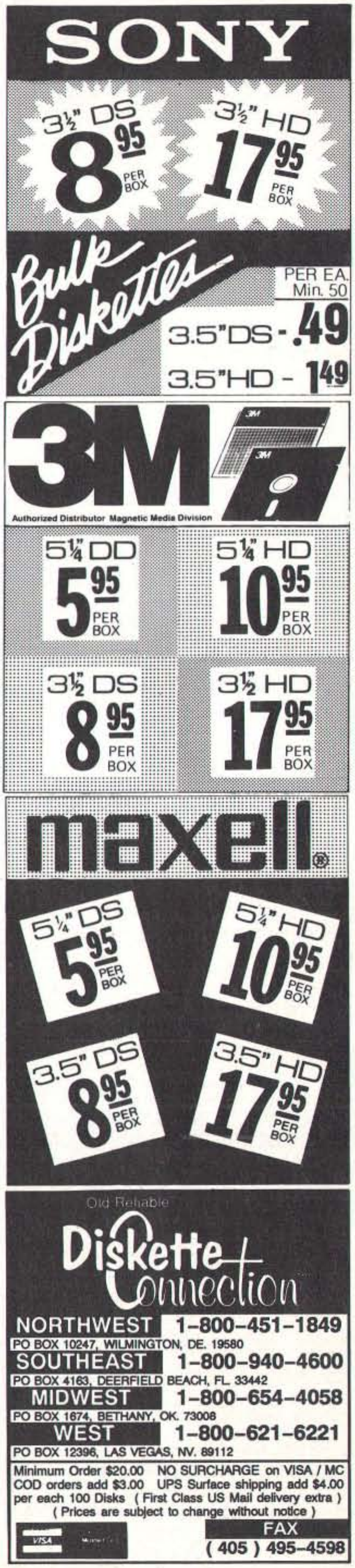
If you ever have a problem, remember to deal first with the seller. If you cannot resolve the problem, write to MAIL ORDER ACTION LINE, c/o DMA, 6 E. 43rd St., New York, NY 10017.

This message is brought to you by:

the MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.
6 E. 43rd St.,
New York, NY 10017

MMC
MICROCOMPUTER MARKETING COUNCIL
of the Direct Marketing Association, Inc.


prfrd, but will train. All bene.
We are an equal opportunity/
affirmative action employer.
IMPORTANT
HIGH LEVEL
POSITION
Excellent opportunity for rewarding international career challenge. Candidate must have skills, motivation and interest in people for this self-actualizing job. All living expenses fully paid. Chance to travel. Age no barrier.
The toughest job you'll ever love.
Call Peace Corps.
1-800-424-8580, Ext. 93.
MANAGER.
Large national bank seeks
Ad Council
Photo by Alan Reininger


SONY
3½" DS 8.95 PER BOX
3½" HD 17.95 PER BOX
Bulk Diskettes
PER EA. Min. 50
3.5"DS - .49
3.5"HD - 1.49
3M
Authorized Distributor Magnetic Media Division
5¼" DD 5.95 PER BOX
5¼" HD 10.95 PER BOX
3½" DS 8.95 PER BOX
3½" HD 17.95 PER BOX
maxell®
5¼" DS 5.95 PER BOX
5¼" HD 10.95 PER BOX
3.5" DS 8.95 PER BOX
3.5" HD 17.95 PER BOX
Old Reliable
Diskette Connection
NORTHWEST 1-800-451-1849
PO BOX 10247, WILMINGTON, DE. 19580
SOUTHEAST 1-800-940-4600
PO BOX 4163, DEERFIELD BEACH, FL. 33442
MIDWEST 1-800-654-4058
PO BOX 1674, BETHANY, OK. 73008
WEST 1-800-621-6221
PO BOX 12396, LAS VEGAS, NV. 89112
Minimum Order $20.00 NO SURCHARGE on VISA / MC
COD orders add $3.00 UPS Surface shipping add $4.00
per each 100 Disks (First Class US Mail delivery extra)
(Prices are subject to change without notice)
FAX
(405) 495-4598

JDR Microdevices®

MMC MICROCOMPUTER MARKETING COUNCIL of the Direct Marketing Association, Inc.

• 30 DAY MONEY BACK GUARANTEE • 1 YEAR WARRANTY ON ALL PRODUCTS • TOLL-FREE TECHNICAL SUPPORT

DYNAMIC RAMS

PART#	SIZE	SPEED	PINS	PRICE
4116-150	16384x1	150ns	16	1.49
4164-150	65536x1	150ns	16	2.49
4164-120	65536x1	120ns	16	2.89
4164-100	65536x1	100ns	16	3.39
TMS4464-12	65536x4	120ns	16	3.95
41256-150	262144x1	150ns	16	2.59
41256-120	262144x1	120ns	16	2.95
41256-100	262144x1	100ns	16	3.15
41256-80	262144x1	80ns	16	3.75
414256-100	262144x4	100ns	20	12.95
414256-80	262144x4	80ns	20	13.45
1 MB-120	1048576x1	120ns	18	11.95
1 MB-100	1048576x1	100ns	18	12.35
1 MB-80	1048576x1	80ns	18	13.95

SIMM/SIP MODULES

PART#	SIZE	SPEED	FOR	PRICE
41256A9B-12	256K x 9	120ns	SIMM/PC	36.95
41256A9B-80	256K x 9	80ns	SIMM/PC	49.95
421000A8B-10	1MB x 8	100ns	SIMM/MAC	109.95
421000A9B-10	1MB x 9	100ns	SIMM/PC	113.95
421000A9B-80	1MB x 9	80ns	SIMM/PC	119.95
256K9SIP-80	256K X 9	80ns	SIP/PC	54.95
256K9SIP-60	256K X 9	60ns	SIP/PC	64.95
1MBx9SIP-80	1MB x 9	80ns	SIP/PC	124.95

MATH COPROCESSORS

intel® 5 YEAR WARRANTY

8-BIT COPROCESSORS

8087	5 MHz	89.95
8087-2	8 MHz	129.95
8087-1	10 MHz	169.95

16-BIT COPROCESSORS

80287	6 MHz	139.95
80287-8	8 MHz	209.95
80287-10	10 MHz	239.95
80C827	12MHZ	299.95

32-BIT COPROCESSORS

80387-16	16 MHz	359.95
80387-SX	16 MHz	319.95
80387-20	20 MHz	399.95
80387-25	25 MHz	499.95
80387-33	33MHz	649.00

INCLUDES MANUAL & SOFTWARE GUIDE

Littlefoot™ CASE $249.95

- ACCOMODATES ALL MOTHERBOARD SIZES
- INCLUDES 250 WATT POWER SUPPLY
- MOUNTS FOR 3 FLOPPY & 4 HARD DRIVES
- TURBO AND RESET SWITCHES
- SPEED DISPLAY, POWER, DISK LEDS
- MOUNTING HARDWARE, FACEPLATES AND SPEAKER INCLUDED

CASE-100

CASE-200 "SUPERFOOT"-HOLDS 11 DRIVES $499.95
CASE-120 "MINIFOOT" W/200 WATT PS $199.95

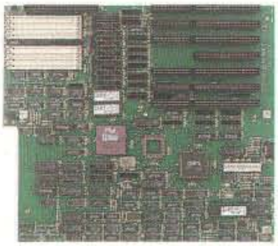
STANDARD CASES

CASE-70 FULL SIZE SLIDE CASE $89.95
CASE-50 FOR 8088 OR MINI-86 MOTHERBOARDS $59.95
CASE-FLIP FLIP-TOP XT-STYLE CASE $39.95
CASE-SLIDE SLIDE TYPE XT-STYLE CASE $39.95
CASE-JR $149.95
WITH150W POWER SUPPLY. FOR 8088 OR MINI-286 BOARDS.
CASE-JR-200 .... $189.95
WITH 200W POWER SUPPLY. FOR 8088 OR MINI-286 BOARDS.
NOTE: CASES DO NOT INCLUDE DRIVES.

UL APPROVED POWER SUPPLIES

PS-135 135 WATT FOR 8088 .... $59.95
PS-155 150 WATT FOR 8088 .... $69.95
PS-200X 200 WATT FOR 8088 .... $89.95
PS-200 200 WATT FOR 286/386 .... $89.95
PS-250 250 WATT FOR 286/386 .... $129.95

YOUR MOTHERBOARD CONNECTION!



"OUR FASTEST" 33MHZ CACHE 386 $1495

• NORTON SI 45.9 • LANDMARK AT SPEED 50.8

• 33MHZ 80386 MPU • 64K ZERO WAIT STATIC RAM CACHE • 1/2/4/8MB ON-BOARD RAM USING 80NS SIMMS (ØKB INSTALLED) • 1/2MB USING 4/8 256K SIMMS OR 4/8MB USING 4/8 1MB SIMMS • CHIPS & TECHNOLOGY 82C206 DMA INTERRUPT CONTROLLER • SOCKETED FOR 80387-33 MATH CO-PROCESSOR • EIGHT EXPANSION SLOTS (ONE 32-BIT, SIX 16-BIT, ONE 8-BIT) • AMI BIOS ASSURES IBM COMPATIBILITY • 8/33MHZ KEYBOARD ADJUSTABLE SPEEDS

MCT-386MBC-33 .... $1495.00

25MHZ 386 $999

• NORTON SI 29.7 • LANDMARK AT SPEED 32.5

• 25MHZ 80386 MPU • 10MHZ/25MHZ KEYBOARD SELECTABLE SPEEDS • 16MB ON-BOARD RAM CAPACITYUSING SIPS (ØKB INSTALLED) • 1/2MB USING 36/72 256KX1 DRAMS OR 4/8 256K SIPS; 4/8MB USING 36/72 1MBX1 DRAMS OR 4/8 1MB SIPS; 16MB USING 72 1MBX1 DRAMS AND 8 1MB SIPS • SHADOW RAM FOR BIOS & VIDEO • SOCKETED FOR WEITEK 3167 COPROCESSOR • EIGHT EXPANSION SLOTS (FIVE 16-BIT, THREE 8-BIT) • AMI BIOS ADJUSTABLE BUS SPEEDS • INTERLEAVED MEMORY• NEAR Ø WAIT STATE

MCT-386MB25S

20MHZ 386 $799

MCT-386MB20S • NORTON SI 23.0 • LANDMARK AT 25.8

MINI 25MHZ CACHE 386

• NORTON SI 30.5 • LANDMARK AT SPEED 40.7

• 25MHZ 80386 • REQUIRES ONE OF THE RAM CARDS LISTED BELOW • SHADOW RAM FOR ROM BIOS • USES MEMORY CACHING FOR SUPERIOR PERFORMANCE • MEMORY INTERLEAVING FOR NEAR Ø WAIT STATE OPERATION (8 BANKS OF MEMORY REQUIRED) • SOCKETED FOR 80387 OR WEITEK 3167 COPROCESSORS

MCT-C386-25 .... $1199.00

1/2/4MB USING 8/16/32 256KX4 DRAMS & 4/8/16 256KX1 DRAMS (ØK INSTALLED)

MCT-C386-M4 .... $99.95

1/2MB USING 36/72 256KX1 DRAMS OR 4/8MB USING 36/72 1MBX1 DRAMS (ØK INST)

MCT-C386-M8 .... $99.95

1/2/4MB USING 4/8/16 256K SIMMS, 4/8/16MB USING 4/8/16 1MB SIMMS OR 10 MB USING 8 1MB SIMMS AND 8 256K SIMMS (ØK INSTALLED)

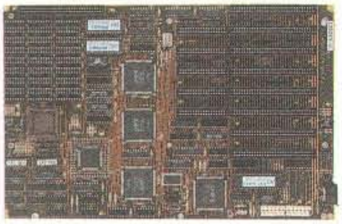
MCT-C386-M16 .... $99.95

MINI 20MHZ 386 $629

• NORTON SI 23.0 • LANDMARK AT SPEED 26.1

• MEMORY INTERLEAVING FOR NEAR ZERO WAIT STATES • SOCKETED FOR 80387 COPROCESSOR • USES 80NS OR 100NS, 256K OR 1MB SIP/DIP RAMS • 16MB RAM CAPACITY: 8MB ON BOARD, 8MB USING OPTIONAL RAM CARD (ØKB INSTALLED) • ON-BOARD RAM: 1/2MB USING 4/8 256K SIPS OR 4/8MB USING 4/8 1MB SIPS • FIVE 16-BIT SLOTS, TWO 8-BIT SLOTS, ONE 32-BIT SLOT FOR PROPRIETARY RAM CARD • STANDARD XT HOLE SPACING • AMI BIOS • SIZE: 8.5" X 13"

MCT-M386-20 20MHZ VERSION $629.00
MCT-M386-25 25MHZ VERSION $799.00



16MHZ MINI 386-SX $399.95

• NORTON SI 15.3 • LANDMARK AT SPEED 20.8

• USES 16MHZ INTEL 80386SX CPU • EXPANDABLE TO 8MB ON BOARD • 512K/1MB USING 18/36 256KX1 DRAMS OR 2/4 256K SIPS OR 4/8 256KX4 AND 2/4 256KX1 DRAMS; 2/4MB USING 18/36 1MBX1 DRAMS OR 2/4 1MB SIPS; 6/8MB USING 36 1MBX1 DRAMS AND 2/4 1MB SIPS AMI BIOS • CHOOSE FAST Ø WAIT STATE OR 1 WAIT STATE FOR ECONOMICAL USE OF SLOWER RAM • FIVE 16-BIT & THREE 8-BIT EXPANSION SLOTS • CHIPS & TECHNOLOGY NEW ENHANCED ADVANCED TECHNOLOGY (NEAT) CHIPSET • SOCKET FOR 80387SX-16 COPROCESSOR • 8.5" X 13" SIZE FITS IN MINI-AT AND FULL-SIZE AT CASES

MCT-386SX $399.95

20MHZ 286 $389.95

• NORTON SI 20.3 • LANDMARK AT SPEED 26.3

• NEAT CHIPSET HAS POWER TO COMPETE WITH 386 SYSTEMS • EXPANDABLE FROM 512K TO 8MB; 512K/1MB USING 18/36 256KX1 DRAMS OR 2/4 256K SIPS; 2/4MB USING 18/36 1MBX1 DRAMS OR 2/4 1MB SIPS; 6/8MB USING 36 1MBX1 DRAMS AND 2/4 1MB SIPS • 20/10MHZ KEYBOARD SELECTABLE SPEEDS • AMI BIOS • SHADOW RAM AND PAGE INTERLEAVED MEMORY • FAST Ø WAIT STATE OR 1 WAIT STATE FOR SLOWER RAM • 8.5" X 13" FITS MOST XT, MINI-AT & FULL SIZE AT CASES • FIVE 16-BIT & THREE 8-BIT SLOTS • SOCKET FOR 80287-12 MATH CO-PROCESSOR

MCT-M286-20N

16MHZ 286 W/NEAT CHIPSET $289.95

MCT-M286-16N NORTON SI 16.2 / LANDMARK AT 21.1

12MHZ 286 W/NEAT CHIPSET $269.95

MCT-M286-12N NORTON SI 12.0 / LANDMARK AT 15.5

12.5MHZ 286 $199.95

• NORTON SI 14.3 • LANDMARK AT SPEED 16.5

• AT-COMPATIBLE • 6/12.5MHZ KEYBOARD SELECTABLE SPEEDS • EXPANDABLE TO 4MB ON BOARD; 512K/1MB USING 18/36 256KX1 DRAMS; 2/4MB USING 18/36 1MBX1 DRAMS (ØKB INSTALLED) • MEMORY SPEED: 120NS FOR 1 WAIT, 100NS FOR Ø WAIT

MCT-M286-12 .... $199.95
MCT-M286-10 6/10MHZ VERSION $189.95

10MHZ 8088 NORTON SI 2.1 $99.95

• NOW USES LOW-COST 256K X 4 1MB DRAMS • XT COMPATIBLE; OPERATES AT 4.77/10MHZ • KEYBOARD SELECTABLE CLOCK SPEEDS • SOCKET FOR 8087-1 COPROCESSOR • 8 SLOTS • MCT BIOS • 640K RAM CAPACITY (ØKB INSTALLED)

MCT-TURBO-10 .... $99.95
MCT-TURBO 8MHZ VERSION $89.95

JDR MICRODEVICES 2233 BRANHAM LANE, SAN JOSE, CA 95124 (408) 559-1200
FAX (408) 559-0250 TELEX 171-110
RETAIL STORE: 1256 S. BASCOM AVE., SAN JOSE, CA (408) 947-8881
HOURS: M-F 9-7, SAT. 9-5, SUN. 12-4

ORDER TOLL-FREE 800-538-5000

CUSTOMER SERVICE 800-538-5001 TECH SUPPORT 800-538-5002
MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)

VISA MasterCard

Circle 6 on Reader Service Card (DEALERS: 7)

MICROPOLIS

HIGH SPEED HARD DRIVES

KITS INCLUDE: FAST FLOPPY/HARD CONTROLLER, CABLES, INSTALLATION GUIDE & NOVELL NETWARE-286 SOFTWARE

SIZE	MODEL	AVG. SPEED	INTER FACE	DRIVE PRICE	KIT PRICE
157.5MB	1355	23MS	ESDI	$949	$1049
157.5MB	1375	23MS	SCSI	$999	$1099
338.1MB	1558	18MS	ESDI	$1619	$1799
338.1MB	1578	18MS	SCSI	$1619	$1799
676.8MB	1568	16MS	ESDI	$2499	-
676.8MB	1588	16MS	SCSI	$2499	-

HARD DISKS

21.4MB $199 65.5MB $389

32.7MB $219 80.2MB $569

42.8MB $339 84.9MB $499

DRIVE KITS

21.4MB $249

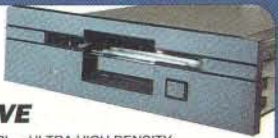
32.7MB $279

Seagate

SIZE	MODEL	AVG. SPEED	FORM FACTOR	DRIVE ONLY	XT KIT	AT F/H KIT
21.4MB	ST-225	65MS	5-1/4"	$199	$249	$309
32.7MB RLL	ST-238	65MS	5-1/4"	$219	$279	$379
42.8MB	ST-251-1	28MS	5-1/4"	$339	$389	$449
43.1MB SCSI	ST-251N	40MS	5-1/4"	$419	-	-
65.5MB RLL	ST-277-1	28MS	5-1/4"	$389	$449	$549
80.2MB	ST-4096	28MS	5-1/4"	$569	-	$679
84.9MB SCSI	ST-296N	28MS	5-1/4"	$499	-	-
122.7MB RLL	ST-4144R	28MS	5-1/4"	$699	$759	$859
21.4MB	ST-125	40MS	3-1/2"	$259	$299	$373
32.1MB RLL	ST-138R	40MS	3-1/2"	$289	$339	$429

KITS INCLUDE HARD DRIVE, DRIVE CONTROLLER, CABLES AND JDR'S DETAILED INSTRUCTION MANUAL

$99.95



1.44MB 3-1/2" DRIVE

- 80 TRACKS • 135 TPI • ULTRA HIGH DENSITY
- READ/WRITE 720K DISKS, TOO
- INCLUDES ALL NECESSARY MOUNTING HARDWARE

FDD-1.44X BLACK FACEPLATE
FDD-1.44A BEIGE FACEPLATE
FDD-1.44SOFT SOFTWARE DRIVER $19.95
MF355A 3-1/2" MITSUBISHI 1.44MB, BEIGE $129.95
MF355X 3-1/2" MITSUBISHI 1.44MB, BLACK $129.95
FDD-360 5-1/4" DOUBLE-SIDED DD 360K $69.95
FD-55B 5-1/4" TEAC DOUBLE-SIDED DD 360K $99.95
FDD-1.2 5-1/4" DOUBLE-SIDED HD 1.2M $95.95
FD-55G 5-1/4" TEAC DOUBLE-SIDED HD 1.2M $129.95

"...because I'm so happy, I have decided to make you my computer vendor for life!"
—John Erwin, San Jose CA

PROMETHEUS

9600 BAUD V.32 MODEM $699

• 9600/4800/2400/1200 BPS • FULL DUPLEX • ASYCHRONOUS/SYNCHRONOUS • MNP-5 FOR 100% ERROR FREE TRANSMISSIONS • CCITV.32, V.22/BIS/V.22, BELL/212A COMPATIBLE • DATA COMPRESSION ALLOWS 19.2K BAUD
PRO-96E

EXTERNAL 2400 BAUD $149.95

• 2400/1200/300 BPS • REQUIRES SERIAL PORT & CABLE
PRO-24E
PRO-24I 2400 BAUD INTERNAL MODEM 1/2 CARD $99.95

MODULAR CIRCUIT TECHNOLOGY

4800/2400 BPS FAX MODEM $149.95

• 4800 BAUD GROUP III FAX TRANSMISSION ONLY • 2400 BPS DATA MODEM • MENU DRIVEN PROFAX SOFTWARE • SENDS DOS TEXT, PCX & TIFF FILES TO FAX TRANS.
MCT-FAXM
MCT-24I INTERNAL 2400 BAUD DATA MODEM $89.95
MCT-12I INTERNAL 1200 BAUD DATA MODEM $69.95

VIVA 2400 BAUD $139.95

STATE-OF-ART DESIGN AND PERFORMANCE • 2400/1200/300 BAUD OPERATION • FULLY HAYES AT COMMAND SET COMPATIBLE • EXTENDED S-REGISTER PROGRAMMING • 8 INTERNATIONAL ICON STAUS LIGHTS • BUILT-IN SPEAKER • 2ND PHONE JACK FOR VOICE • AUTO WAIT FOR DIAL TONE & AUTO REDIAL • STANDARD RS-232C INTERFACE • "GRANITE LOOK" BASE
VIVA-24E

new!

MODULAR CIRCUIT TECHNOLOGY INTERFACE CARDS

DRIVE CONTROLLERS

1.44MB FLOPPY $49.95

• XT OR AT COMPATIBLE • SUPPORTS 2 FLOPPY DRIVES (360K, 720K, 1.2MB & 1.44MB) • USER SELECTABLE AS A PRIMARY OR SECONDARY (3RD OR 4TH) FLOPPY DRIVE
MCT-FDC-HD

HIGH DENSITY 4-FLOPPY CARD $59.95

• INTERFACES UP TO 4 FLOPPY DRIVES • CABLES FOR 4 INTERNAL DRIVES • BIOS SUPPORTS ANY COMBINATION OF DRIVES (360K/720K/1.2MB/1.44MB)
MCT-FDC-HD4

FLOPPY DISK $29.95

• INTERFACES UP TO 4 FLOPPY DRIVES TO IBM PC OR COMPATIBLE • DS/DD AND DS/QD COMPATIBLE
MCT-FDC

HARD DISK $79.95

• SUPPORTS 16 DRIVE SIZES INCLUDING 10, 20, 30 AND 40MB• CAN DIVIDE 1 LARGE DRIVE INTO 2 LOGICAL DRIVES
MCT-HDC
MCT-RLL RLL CARD SUPPORTS 2 RLL DRIVES $89.95

286/386 FLOPPY/HARD $149.95

• FLOPPY/HARD DISK CONTROL IN AN AT DESIGN • FOR UP TO 2 FLOPPIES (360K/720K/1.2MB/1.44MB) & 2 HARD DRIVES
MCT-AFH

286/386 1:1 INTERLEAVE $169.95

• CONTROLS 2 HARD & 2 FLOPPY DRIVES (360K/720K/1.2MB/1.44MB) • CONCURRENTLY USE HARD & FLOPPY DRIVES
MCT-FAFH

MEMORY CARDS

576K RAM CARD $49.95

• USER SELECTABLE CONFIGURATION TO 576K • USES 64K AND 256K DRAMS (ØK INSTALLED)
MCT-RAM

286/386 EXPANDED MEMORY $129.95

• USER EXPANDABLE TO 2MB USING1MB DRAMS • CONFORMS FULLY TO LIM EMS 3.2 • RAM DISK SOFTWARE
MCT-AEMS
MCT-EMS XT COMPATIBLE EMS CARD $99.95

MULTIFUNCTION I/O CARDS

MULTI I/O CARD $59.95

• SERIAL PORT • CLOCK/CALENDAR WITH BATTERY
• PARALLEL PORT IS ADDRESSABLE AS LPT1 OR LPT2
MCT-IO

MULTI I/O FLOPPY $79.95

• SUPPORTS UP TO 2 360K FLOPPIES
• SERIAL, PARALLEL, GAME PORT AND CLOCK/CALENDAR
MCT-MIO

MONOGRAPHICS MULTI I/O $119.75

• CONTROL 2 FLOPPIES • SERIAL, PARALLEL, GAME PORT, CLOCK/CALENDAR • RUNS COLOR GRAPHICS SOFTWARE ON YOUR BLACK AND WHITE MONITOR
MCT-MGMIO

286/386 MULTI I/O CARD $59.95

• SERIAL, PARALLEL AND GAME PORTS • USES 16450 SERIAL SUPPORT CHIPS FOR HIGH SPEED OPERATION
MCT-AIO

DISPLAY CARDS

16-BIT VGA $199.95

• 640 X 480 IN 16 COLORS • 256K VIDEO RAM EXPAND-ABLE TO 512K • 64 LEVELS OF GRAY SCALE
MCT-VGA-16
MCT-VGA-8 8-BIT VERSION $169.95

EGA CARD $149.95

• 640 X 350 HIGH RESOLUTION • DISPLAYS 16 COLORS AT A TIME • COMPATIBLE WITH HERCULES, CGA AND IBM MONOCHROME • SOFTWARE DRIVERS FOR WINDOWS, LOTUS, CAD, AND MORE • 256K VIDEO RAM
MCT-EGA

CGA CARD $44.95

IBM-COMPATIBLE ADAPTOR FOR RGB MONITORS • 640 X 200 MONO, 320 X 200 COLOR RESOLUTION • DISPLAYS 4 COLORS SIMULTANEOUSLY • LIGHT PEN INTERFACE
MCT-CG
MCT-CGP WITH PRINTER PORT $49.95
CG-COMP COMPOSITE ADAPTOR $4.95

MONO GRAPHICS $49.95

XT AND AT-COMPATIBLE • HERCULES COMPATIBLE MONOGRAPHICS • SUPPORTS LOTUS 1-2-3 • HIGH RESOLUTION 720 X 348 DISPLAY • VLSI CHIPS • CONFIGURE THE PARALLEL PRINTER PORT AS LPT1 OR 2
MCT-MGP

FAX SWITCHER $109.95

CONNECT ONE PHONE LINE TO YOUR PHONE, FAX, MODEM AND ANSWERING MACHINE --THIS DEVICE ROUTES THE CALLS! • OPERATES ON SINGLE OR MULTI-LINE SYSTEMS • AUX. PORT FOR MODEM, CORDLESS PHONE, ALARM, POS TERMINAL, ETC.
FAXM-SWITCH

DFI ETHERNET CARD $199.95

• 100% HARDWARE COMPATIBLE WITH NOVELL NE-1000 ETHERNET CARD
• FOR THICK OR THIN ETHERNET
• 15-PIN ETHERNET CONNECTOR
• BNC CONNECTOR FOR THIN ETHERNET
DFINET-300 8-BIT VERSION
DFINET-400 16-BIT VERSION $239.95

JIM'S BARGAIN HUNTERS CORNER

Jim Wharton
JDR's VP Sales

$999

25MHZ CACHE 386 MOTHERBOARD

REGULAR LIST $1099.00 • 25MHZ 80386 MPU • 64K ZERO WAIT STATE STATIC RAM CACHE • 1/2/4/8MB ON-BOARD RAM USING 80 NS SIMMS (ØKB INSTALLED) • CHIPS & TECHNOLOGY 82C206 DMA INTERRUPT CONTROLLER • SOCKETED FOR 80387-25 MATH COPROCESSOR • EIGHT EXPANSION SLOTS (ONE 32-BIT, SIX 16-BIT & ONE 8-BIT) • AMI BIOS ASSURES IBM COMPATIBILITY • 8/25MHZ KEYBOARD SELECTABLE SPEEDS
MCT-386MBC-25 EXPIRES 4/30/90

TERMS: Minimum order $10.00. For shipping and handling include $3.50 for UPS Ground and $4.50 for Air. Orders over 1 lb. and foreign orders may require additional shipping charges - contact the sales department for the amount. CA. residents must include applicable sales tax. Prices are subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities & to substitute manufacturer. All merchandise subject to prior sale. A full copy of our terms is available upon request. Items shown may only be representative.

ORDER TOLL-FREE 800-538-5000

CUSTOMER SERVICE 800-538-5001 TECH SUPPORT 800-538-5002

MON.-FRI. 7 A.M. TO 5 P.M., SATURDAY, 9 A.M. TO 3 P.M. (PST)

VISA MasterCard

Circle 6 on Reader Service Card (DEALERS: 7)

EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

The BYTE On-Going Utility in Space (BOGUS) tests: **APRIL FOOL**

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Alphabetical Index to Advertisers

EUROPE & WORLD SECTION 52 E&W 1–84

No North American Inquiries please.

READER SERVICE

Advertising Supplement included with this issue:
Jade Computer (U.S. and Canada Subscribers)
Circle 316 on Reader Service Card
*Correspond directly with company.

Inquiry No.		Page No.
*	SOFTLINE CORP	E&W-43
322	SOFTWARE DMI	E&W-66
321	SOLUTION SYSTEMS	E&W-61
334	SPECTRA PUBLISHING	E&W-81
323	SYSTEMSTAR LTD	E&W-53
*	TOPS	E&W-31
324	TP ENTERPRISE LTD	E&W-60
406	TREND MICRO DEVICES,INC	E&W-47
407	TREND MICRO DEVICES,INC	E&W-47
325	TRIANGLE DIGITAL SERVICES	E&W-70
326	TRIGEM COMPUTER	E&W-2
332	TWINHEAD INT'L CORP	E&W-83
327	USA SOFTWARE	E&W-33
328	VASCO SONG CHEER	E&W-50
329	VIKING SOFTWARE SERV	E&W-32
330	WIESEMANN & THEIS GMBH	E&W-62

E&W DIRECT RESPONSE POSTCARDS

*	BYTEWEEK/NEWSLETTER	E&W
*	COMPUTER BUYERS GUIDE/VULCAN	E&W
*	GATEWAY 2000	E&W
*	METRABYTE	E&W
*	PROGRAMMERS JOURNAL	E&W
*	REASONABLE SOLUTIONS	E&W

REGIONAL SECTIONS

Midwest 52 MW1–16

*	BIX	MW-6
507	EKM	MW-6
508	EKM	MW-6
509	GALACTICOMM	MW-4
*	MICROCOMPUTING MKTG.CNCL	MW-14
510	MICRO IMAGE INTERNATIONAL	MW-2
511	MICRO IMAGE INTERNATIONAL	MW-2
512	OMEGA SYSTEMS	MW-13
513	OMEGA SYSTEMS	MW-13
514	PAO-KU INTERNATIONAL LTD	MW-3
515	PAO-KU INTERNATIONAL LTD	MW-3
516	PERSONAL COMPUTER ENTERPRISE	MW-7
517	PERSONAL COMPUTER ENTERPRISE	MW-7
518	REASON TECHNOLOGY	MW-11
519	RESOURCE CONCEPTS,INC	MW-5
520	RESOURCE CONCEPTS,INC	MW-5
521	SHEBRO COMPUTERS,INC	MW-9
522	SHEBRO COMPUTERS,INC	MW-9
523	SIA	MW-16
524	SIA	MW-16

Northeast 52 NE1–24

*	BIX	NE-22
525	BOFFIN LTD	NE-23
526	BOFFIN LTD	NE-23
527	CDC,INC	NE-21
528	CDC,INC	NE-21
529	COMDEK	NE-22
530	EDWIN SYSTEMS CORP	NE-19
531	EDWIN SYSTEMS CORP	NE-19
532	GALACTICOMM	NE-2
533	HARMONY COMPUTERS	NE-3
534	HARMONY COMPUTERS	NE-3
535	LAPTOPS,ETC	NE-4
536	MANCHESTER EQUIPMENT	NE-24
537	MANCHESTER EQUIPMENT	NE-24A–B
538	MASCOT COMPUTER CORP	NE-9
*	MICROCOMPUTING MKTG.CNCL	NE-20
539	MICRO DATABASE SYSTEMS	NE-11
540	MICRO DATABASE SYSTEMS	NE-11
541	MICRO IMAGE INTERNATIONAL	NE-10
542	MICRO IMAGE INTERNATIONAL	NE-10
543	PAO-KU INTERNATIONAL LTD	NE-5
544	PAO-KU INTERNATIONAL LTD	NE-5
545	PC LINK CORPORATION	NE-17
546	REASON TECHNOLOGY	NE-16
547	RESOURCE CONCEPTS,INC	NE-13
548	RESOURCE CONCEPTS,INC	NE-13
549	SAGE/POLYTRON	NE-6,7
550	SIA	NE-14
551	SIA	NE-14
552	TRIPP LITE	NE-10
553	TRIPP LITE	NE-10

Pacific Coast 52 PC1–20

476	COMPUTER AIDED TECH	PC-18
477	COMPUTER AIDED TECH	PC-18
*	COMPUTERS FOR THE BLIND	PC-11
478	CONVEX RESOURCES	PC-9
479	DP-TEK	PC-14
480	DP-TEK	PC-14
481	DST	PC-6
482	EKM	PC-18
483	EKM	PC-18
486	GALACTICOMM	PC-4
487	HANZON DATA,INC	PC-5
488	HANZON DATA,INC	PC-5
489	HANZON DATA,INC	PC-6
490	HANZON DATA,INC	PC-6
491	METAWARE	PC-15
*	MICROCOMPUTING MKTG.CNCL	PC-10
492	MICRO IMAGE INTERNATIONAL	PC-2
493	MICRO IMAGE INTERNATIONAL	PC-2
496	ORANGE MICRO	PC-17
497	ORANGE MICRO	PC-17
498	PAO-KU INTERNATIONAL LTD	PC-7
499	PAO-KU INTERNATIONAL LTD	PC-7
500	RESOURCE CONCEPTS,INC	PC-19
501	RESOURCE CONCEPTS,INC	PC-19
502	SIA	PC-20
503	SIA	PC-20
504	TOP LINK CONPUTER	PC-14
505	UNITED INNOVATIONS	PC-3
506	ZERICON,INC	PC-13

South 52 SO1–16

554	BOFFIN LTD	SO-7
555	BOFFIN LTD	SO-7
556	BROAD MARKETING ASSOC	SO-8
557	BROAD MARKETING ASSOC	SO-8
558	CRAZY NANCY'S	SO-5
559	CRAZY NANCY'S	SO-5
560	GALACTICOMM	SO-4
*	MICROCOMPUTING MKTG.CNCL	SO-12
561	OMEGA SYSTEMS	SO-14
562	OMEGA SYSTEMS	SO-14
563	PAO-KU INTERNATIONAL LTD	SO-9
564	PAO-KU INTERNATIONAL LTD	SO-9
565	RESOURCE CONCEPTS,INC	SO-15
566	RESOURCE CONCEPTS,INC	SO-15
567	SHEBRO COMPUTERS,INC	SO-3
568	SHEBRO COMPUTERS,INC	SO-3
569	SIA	SO-16
570	SIA	SO-16
571	SOFT&MORE	SO-11
572	TRIPP LITE	SO-2
573	TRIPP LITE	SO-2
574	ZERICON,INC	SO-13

BYTE ADVERTISING SALES STAFF:

Steven M. Vito, Associate Publisher/V.P. of Marketing, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-9281
Arthur Kossack, Eastern Regional Sales Manager, 645 North Michigan Ave., Chicago, IL 60611, tel. (312) 751-3700
Jennifer L. Bartel, Western Regional Sales Manager, 8111 LBJ Freeway, Suite 1350, Dallas, Tx 75251, tel. (214) 644-1111
Liz Coyman, Inside Sales Director, One Phoenix Mill Lane, Peterborough, NH 03458, tel. (603) 924-2518

NEW ENGLAND
ME, NH, VT, MA, RI, ONTARIO
CANADA & EASTERN CANADA
Dan Savage **(617) 262-1160**
McGraw-Hill Publications
575 Boylston Street
Boston, MA 02116
FAX: (617) 262-6430

ATLANTIC
NY, NYC, CT, NJ (NORTH)
Kim Norris **(212) 512-2645**
McGraw-Hill Publications
1221 Avenue of the Americas—
28th Floor
New York, NY 10020
FAX: (212) 512-3520

EAST
PA, NJ (SOUTH),
MD, W.VA, DE, D.C.
Thomas J. Brun **(215) 496-3833**
McGraw-Hill Publications
Three Parkway
Philadelphia, PA 19102
FAX: (215) 496-3828

SOUTHEAST
NC, SC, GA, FL, AL, TN, VA,
MS, AR, LA
John Y. Schilin **(404) 252-0626**
McGraw-Hill Publications
4170 Ashford-Dunwoody Road
Suite 520
Atlanta, GA 30319
FAX: (404) 252-4056

MIDWEST
IL, MO, KS, IA, ND, SD, MN,
KY, OH, WI, NB, IN, MI
Kurt Kelley **(312) 751-3740**
McGraw-Hill Publications
Blair Building
645 North Michigan Ave.
Chicago, IL 60611
FAX: (312) 751-3767

SOUTHWEST, ROCKY MOUNTAIN
CO, OK, TX,
Alison Keenan **(214) 644-1111**
McGraw-Hill Publications
8111 LBJ Freeway, Suite 1350
Dallas, TX 75251
FAX: (214) 480 8517

NORTH PACIFIC: San Francisco, CA
NORTHERN CA, OR, ID, MT,
WY, NORTHERN NV
Roy J. Kops **(415) 954-9728**
Leslie Hupp **(415) 362-4600**
McGraw-Hill Publications
425 Battery Street
San Francisco, CA 94111
FAX: (415) 954-9786

NORTH PACIFIC: Campbell, CA
SILICON VALLEY, HI, WA, AK,
W. CANADA
Bill McAfee **(408) 879-0371**
McGraw-Hill Publications
1999 South Bascom Ave.
Suite #210
Campbell, CA 95008
FAX: (408) 879-9067

SOUTH PACIFIC: Los Angeles, CA
LOS ANGELES COUNTY, AZ,
NM, NORTHERN NEVADA
Andrew B. Uphoff **(213) 480-5243**
McGraw-Hill Publications
3333 Wilshire Boulevard #407
Los Angeles, CA 90010
FAX: (213) 480-5249

SOUTH PACIFIC: Costa Mesa, CA
ORANGE COUNTY,
SAN DIEGO COUNTY, UT
Ron Cordek **(714) 557-6292**
McGraw-Hill Publications
3001 Red Hill Ave.
Building #1—Suite 222
Costa Mesa, CA 92626
FAX: (714) 557-2219

BYTE BITS (2x3)
Mark Stone **(603) 924-6830**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

The Buyer's Mart (1x2)
Brian Higgins **(603) 924-3754**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Regional Advertising
James Bail **(603) 924-2533**
Barry Echavarria **(603) 924-2574**
Larry Levine **(603) 924-2637**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

National Sales
Mary Ann Goulding
(603) 924-2664
Patricia Payne **(603) 924-2654**
Jonathan Sawyer **(603) 924-2665**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Outsert Sales Program
Scott Gagnon **(603) 924-2651**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

BYTE Deck Mailings
Ed Ware **(603) 924-6166**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Computing for Engineers Deck
Ellen Perham **(603) 924-2598**
BYTE Publications
One Phoenix Mill Lane
Peterborough, NH 03458

Peterborough, NH Office
Inside Sales FAX: 603-924-2683
Advertising FAX: 603-924-7507

International Advertising Sales Staff:

UNITED KINGDOM
Ros Weyman
McGraw-Hill Publishing Co.
34 Dover St.
London W1X 4BR
England 01 493 1451
FAX: 01 493 9896

FRANCE, ITALY
Zena Coupé, Amanda Blaskett
A-Z International Sales Ltd.
4 Ashmount Road, Hornsey Lane
Highgate, London N19 3BH
England 44 1 281 4116
FAX: 44 1 281 8224

GERMANY, BENELUX
Frank Tanis
Batenburg 103
3437 AB Nieuwegein
The Netherlands
31 34 02 49496
FAX: 31 34 02 37944

ISRAEL
Dan Ehrlich
Ehrlich Communication International
P.O. Box 11297
Tel Aviv 61112
Israel
(972) 3-449823
FAX: (972) 3-5468168

SPAIN
Mrs. Maria Sarmiento
Pedro Teixeira 8, Off. 320
Iberia Mart 1
Madrid 4, Spain
1 45 52 891

JAPAN
Masaki Mori
McGraw-Hill Publishing Co.
Overseas Corp.
Room 1528
Kasumigaseki Bldg.
3-2-5 Kasumigaseki,
Chiyoda-Ku
Tokyo 100, Japan
3 581 9811
FAX: 81-3-581-4018

HONG KONG
Seavex Ltd.
503 Wilson House
19-27 Wyndham St.
Central, Hong Kong
Tel: 5-260149
Telex: 60904 SEVEX HX
FAX: 852 810 1283

SINGAPORE
Seavex Ltd.
400 Orchard Road, #10-01
Singapore 0923
Republic of Singapore
Tel: 734-9790
Telex: RS35539 SEAVEX
FAX: 65 732 5129

TAIWAN
Nancy Yin
Thirdwave Publishing Corp.
977 Min Shen E. Road, 1-4 Flr.
Taipei 10581 Taiwan ROC
Tel: 886 2 763 0052

BRAZIL
Mr. Ernest McCrary
Empresa Internacional de
Comunicacoes Ltda.
Rua da Consolacao, 222
Conjunto 103
01302 Sao Paulo, S.P., Brasil
Tel: (11) 259-3811
Telex: (100) 32122 EMBN

READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company.

Index to Advertisers by Product Category

READER SERVICE

Advertising Supplement included with this issue:
Jade Computer (U.S. and Canada Subscribers)
Circle 316 on Reader Service Card
*Correspond directly with company.

REQUEST FREE INFORMATION BY FAX

Attention BYTE Readers!! Now you can fax your requests for free product and advertiser information featured in this issue.

Just fax this page to 1-413-637-4343. You'll save time because your request for information will be processed as soon as your fax is received.

1 Circle the numbers below which correspond to the numbers assigned to advertisers and products that interest you.

2 Check off the answers to questions "A" through "C".

3 Print your name, address, and fax number clearly on the form.

4 Remove this page or copy this page clearly and fax it to the number above.

Fill out this coupon carefully. PLEASE PRINT.

Name ______________________

Title ______________________

Company ______________________

Address ______________________

City ______________________

State/Province ______________ Zip ______

Country ______________________

(____)______________ (____)______________
Phone Number Fax Number

A. What is your level of management responsibility?

1 ☐ Senior-level Management
2 ☐ Other Management
3 ☐ Non-Management

B. What is your primary job function/principal area of responsibility? (Check one.)

4 ☐ Administration
5 ☐ Accounting/Finance
6 ☐ MIS/DP/Information Center
7 ☐ Product Design and Development
8 ☐ Research and Development
9 ☐ Manufacturing
10 ☐ Sales/Marketing
11 ☐ Purchasing
12 ☐ Personnel
13 ☐ Education/Training
14 ☐ Other: ______________

C. Please indicate your organization's primary business activity: (Check one.)

Computer-Related Businesses:

15 ☐ Manufacturer (Hardware, Software)
16 ☐ Computer Retail Stores
17 ☐ Consultants
18 ☐ Service Bureau/Planning
19 ☐ Distributor/Wholesaler
20 ☐ Systems House/Integrator/VAR
21 ☐ Other: ______________

Non-Computer-Related Businesses:

22 ☐ Manufacturing
23 ☐ Finance, Insurance, Real Estate
24 ☐ Retail/Wholesale
25 ☐ Education
26 ☐ Government
27 ☐ Military
28 ☐ Professions (Law, Medicine, Engineering, Architecture)
29 ☐ Consulting
30 ☐ Other Business Services
31 ☐ Transportation, Communications, Utilities
32 ☐ Other: ______________

☐ *I subscribe to BYTE.* ☐ *I do not subscribe to BYTE.*

☐ *Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260
261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300
301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360
361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380
381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420
421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440
441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500
501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520
521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540
541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580
581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600
601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620
621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660
661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700
701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720
721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740
741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760
761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780
781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800
801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820
821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840
841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860
861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880
881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900
901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920
921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940
941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960
961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980
981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020
1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040
1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060
1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080
1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100
1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120
1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140
1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160
1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180
1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200
1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220
1221	1222	1223	1224	1225	1226	1227	1228	1229	1230										

CHAOS MANOR MAIL

Jerry Pournelle answers questions about his column and related computer topics

WordStar Supporter

Dear Jerry,

Your comments on WordStar 5.5 have been great. I switched back to WordStar from WordPerfect 5.0 because WordStar 5.5 does so much more, works so well with other programs, and doesn't tax my memory. I keep hearing about other word processors and the things that they won't do, yet WordStar 5.5 does them. But I've wondered why other reviewers are so adamant about WordStar 5.5 being so bad. I guess it's because they can't change, so they conduct a half-hearted review that makes the product appear ho-hum. WordStar does math; one "in depth" review never mentioned that or that it imports Lotus and dBASE files directly. Another said that the dot commands were outmoded, yet dBASE uses them, and no one is crying about that. I prefer the dot commands so I can see what the thing is doing.

It's nice to read articles from someone who isn't into marketing. BYTE has not succumbed to being a sales catalog for Lotus 1-2-3 or WordPerfect. I'm not cheering for WordStar International; I'm cheering that someone finally looked closely enough at this product.

Mike Gautier
Woodbridge, VA

Thanks. We do try to look at everything. And chances are it will be a long time before BYTE is a sales catalog for anything—we can't get four editors to agree as it is!—Jerry

Orange Aid

Dear Jerry,

I commiserated mightily when I read of your orange-soda-in-the-disk experience in the October 1989 Chaos Manor. The same thing happened to me, to a disk that contained an already late paper I was due to deliver in Kyoto. That experience led me to conduct some experiments as reported in my paper, which is due to be published in *Library HiTech*. (Isn't it amazing what we spend our time doing in library schools?)

Working with 5¼-inch 360K-byte disks, almost nothing—from Chinese food to rye to cat urine—destroyed data. Mess 'em up, wash 'em off, use 'em again. Your event led me to sacrifice more disks: some Dysan high-capacity 5¼-inchers formatted in a 1.2-megabyte IBM drive, and some Verbatim 3½-inch ones, formatted double-sided in a Mac II. I didn't have any orange soda (we're hard-drinking buckaroos out here in Honolulu), but I did pour Pepsi over them, along with some other unpleasant substances. Result: no data loss. I actually had less trouble than I did with the 360K-byte samples (of course, the fact that these were new might have been significant).

The only difficulty that I experienced was in opening the 3½-inch case. I found that the best approach was to pry off the metal read-write slot protector (it's not really needed, anyway), slip a knife blade (tested to make sure it wasn't magnetized) into the edge away from the write-protect switch, and then twist it open like an oyster. I popped open three sides, leaving the left side (with the write-protect switch) attached. This did take a little effort—the things are glued together—but allowed the cookie (i.e., the floppy media proper) to be slipped out. After I washed the crud off the cookies, I dried them—first with a paper towel, then under hot air from the forced-air hand drier in the men's room. (I have never managed to get my hands dry under one of those things, but they work pretty well on disks.) Once the cookies were clean and dry, I put them into a new disk case. Every one of them read perfectly the first time.

I hope this little bit of advice helps you if you ever mess up a disk again. The secret is to take the cookie out before you wash it off, and then put it back in a clean case.

Larry N. Osborne
Honolulu, HI

Thanks. I'm not sure where to get new disk cases, although I suspect that I could find them with some effort. I also wonder if disk cases come with the little felt-like cleaner thing that goes between the cookie and the hard shell?

Mostly I hope it won't happen to me again, but it probably will.—Jerry

Dear Jerry,

Here's what to do when you pour orange soda over your irreplaceable 3½-inch floppy disks:

1. Carefully (so as not to damage the disk itself) disassemble the shutter assembly of the drenched disk and break open the case.
2. Do the same for a discarded disk, this time taking care not to damage the case too much.
3. Wash the drenched disk under running water with any mild dishwashing detergent, and dry with a clean, soft, lint-free cloth.
4. Reassemble the washed disk into the new case. Forget about the shutter unless you really can't copy the data off the disk.

I followed the four steps outlined above with complete success for a disk that I had been carrying in a pocket of my new stone-washed jeans; stone-washed denim contains a good deal of fine sand even after the first few washings, and the disk made unfortunate grating noises when I turned it by hand. Nonetheless, I managed to retrieve all the data.

In general, if a liquid is suited for human consumption (with the possible exception of tequila), it should leave the magnetic coating of the disk intact.

Christopher Ferebee
Königstein, Federal Republic of Germany

Thank you for the instructions; next time I have a disk disaster, I'll be sure to try it!—Jerry ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."

1.5 Decades of April Fools

All right, maybe you can fool some of the people some of the time

Kenneth M. Sheldon

What do Hindsight Engineering, Soycure Systems, and the Famous Programmers' School have in common? Well, for one thing, they're all enterprises that have existed only in the minds of BYTE editors. Over the years, as we've wrestled to keep on top of the fast-moving microcomputer world, we've occasionally taken time out to poke a little fun at ourselves and the industry that we love.

The tradition started in our first April issue (1976), with a Technology Update on the first practical Touring Machine—a bicycle—with a unary relocatable-based operator (i.e., the person on the bike).

Later items detailed such arcane procedures as refolding the fanfold instruction card that came with the MC6809 microprocessor. In 1981, our What's New column featured a new addition to the small components market, the 7N-∞ BHD (black-hole diode), useful mostly for GI (garbage-in) applications. Unfortunately, due to the light-absorption characteristics of the device, we were not able to provide a photograph of the BHD.

Sometimes, items that seemed funny at the time have become, over the years, amazingly prescient: Take the 5-megabyte hard disk drive for the tiny Sinclair ZX81 (marketed in this country as the Timex/Sinclair 1000) that we announced in our April 1982 issue. Hundreds of readers wrote to Hindsight Engineering in "Peanutbutter, New Hampshire" for more information. (Credit the local post office for figuring out where to send the wacky mail.) Nowadays, you can buy a portable as small as the Timex/Sinclair with hard disk drives of up to 100 MB!

Our April 1982 issue also saw the birth of an institution: the Famous Programmers' School. In a full-page "advertisement" that asked, "Do you have a restless urge to program?," readers were offered the rare opportunity to study with such software greats as Bennett Lisp, Bruce Fortran, Red Basic, and the immortal Ignatious "Call Me Blaise" Pascal. Interested parties were asked to take a free aptitude test, with such challenging questions as, "Write down the numbers from zero to nine and the first six letters of the alphabet." Numerous readers took the challenge and responded by sending the required $1000 in small unmarked bills. (Unfortunately, the bills were always Confederate, Monopoly, or homemade money.)

So successful was the Famous Programmers' School that we offered, in the April 1983 issue, a follow-up seminar on pocket-computer local-area networks. The accompanying photo showed the school's stellar staff with pocket computers in hand (and pocket), strung together by a wide ribbon cable.

That seemed pretty funny at the time, but now, with the advent of Xircom's Pocket Ethernet Adapter—a device that lets you attach portable computers to an Ethernet LAN—it seems eerily prophetic. (Note that we considered filing a "look and feel" lawsuit against Xircom but opted instead to give them a BYTE Award of Excellence in our January issue. It's still a good idea, even if we thought of it first.)

The Famous Programmers' School (and most of its instructors) had a last gasp in April 1984, with a plea to "Help the Old Programmers' Home." Situated in a large brick building that looked oddly reminiscent of BYTE's headquarters, the home was founded to provide a calm, tranquil shelter for programmers who were "too old or too burnt-out or have to pay too much alimony." Residents were provided with "good hearty fast food, and an unlimited supply of cola and fanfold paper." Age was of no concern; in fact, some of the residents were "over 35 years old."

Continuing the tradition, our April 1985 issue featured a special "What's Not" section that described several innovative products, such as MacKnifer, a peripheral that attached to the original single-disk Macintosh and let you sharpen knives, scissors, and lawn-mower blades while waiting for files to open.

After that issue hit the stands, we received a call from a woman who said that she'd checked every computer store in town trying to find the Parasoya Disks (made of processed soybeans) that we'd written about. The disks, which were supposedly readable, writable, and edible, were for people who were *really* concerned about protecting sensitive data. Needless to say, she was embarrassed when we explained that the disks (from Soycure Systems) were an April Fools' item.

The very next day, a reporter from *USA Today* called us. He wanted more information about the Transporter, a portable computer that, with a few simple twists, transformed into a single-passenger automobile. They were thinking of running an article about it in their newspaper, but he thought he'd better call first, just to check. Needless to say, that item never appeared in the paper.

As a result of all this, you will find no bogus products in this issue of BYTE. Anything that looks odd or funny—intentionally or not—is thanks to the manufacturer of the product or its advertising agency.

We've learned our lesson. ■

Kenneth M. Sheldon is a senior technical editor for BYTE. He can be reached on BIX as "ksheldon."

PRINT QUEUE

Hugh Kenner

Advise and Compute

A lawyer looks at computers, copyrights, and "look and feel" lawsuits

Thought is structured around certain absolutes: that light moves in vacuo at 299,792.458 kilometers per second; that the mean free path of molecules between collisions is 905 angstrom units; that the worst food in the known universe is on sale in the "A" terminal of the Newark airport.

Human interactions, though, are partly governed by law, and law's benchmarks tend to be prior legal decisions–that is, what someone once persuaded a judge to decide in a case that we are hoping another judge will agree is similar to the case we are now litigating. Trace such a chain back to a primal decision, and behind that you'll expect to find statute law. However, some unclarity as to how the law applied necessitated a first decision.

Concerning software, law has been unclear from the start, as Anthony Clapes details in *Software, Copyright, and Competition: The "Look and Feel" of the Law* (1989, Quorum Books, Westport, CT, $39.95). On page 11 of his highly readable book, Clapes notes that the Founding Fathers in 1788 were at their deliberations nine years before J. M. Jacquard would unveil "the first programmable machine in history," the loom that took an artist's instructions from punched cards. So Article I, Section 8, Clause 8 of the Constitution had no programs in mind when it gave Congress power "To promote the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."

In 1790, Congress enacted the first copyright statute; it covered maps, charts, and books. In 1802, printmakers and graphic artists got included. In 1831, composers of music. In 1865, photographers. In 1870, makers of "paintings, drawings, chromos, statuettes, statuary, and models or designs of fine art." In 1912, the newfangled motion pictures. In 1971, sound recordings (tapes were getting pirated). You see the pattern. Technology kept pushing.

By 1976 it finally had pushed computer programs into the purview of Congress, and Congress was most unhappy. All Congress found itself able to say in 1976 was that computer programs were, yes, protected. But they were to have "no greater protection than they had enjoyed under prior law," which had never mentioned them.

Do not hasten to acclaim our Congresscritters. For by 1980 they'd enacted a most equivocal law, which (1) defined a "computer program"; (2) said that if you owned a copyrighted program you weren't infringing if you used it in a computer (!) or made an archival copy; and (3) deleted the "prior law" clause of 1976, which was meaningless anyhow. And that's where things stand today.

So we're back in the courts, where, says Clapes, lawyers fall very neatly into four categories: They either (1) haven't got time to learn what programming is all about, and don't; (2) decide not to take the time to learn, because judges and juries will never figure it out either, and don't; (3) being Luddites at heart, are constitutionally incapable of learning about programming, so don't; or (4) think they, yes, understand programming, but don't.

Which sets the stage for the generic case, *Apple* v. *Franklin*, 1982. The Franklin Ace, if you recall, was an Apple clone, back when Apple was synonymous with personal computing. And at Franklin, the company had simply copied the Apple operating system into ROM, so clumsily that one Apple programmer's name was left embedded in the code, as was the word *Applesoft*.

Franklin never denied the copying. The company's argument was this: For a machine to run existing Apple software, it needed to have

continued

ILLUSTRATION: CARY HENRIE © 1990

the operating system just about exactly as it was, since the operating system offered so many "entry points" that various software writers were using. The governing ideas, true, Apple couldn't copyright those; but compatibility with all that software—the only reason for a clone—had tied Franklin to nearly line-for-line specifics.

A Philadelphia judge named Newcomer nearly bought that; or rather, he bought something far more sweeping, the idea that programs, since their binary code isn't meant to be read by humans, aren't covered by any statute governing "expression." He feared a step "into the world of Gulliver, where horses are 'human' because they speak a language that sounds remarkably like the one humans use." Do such sequences as 00101001 00110000 merit the protections we accord to *Moby Dick*?

This book clarifies why court decisions are not intuitive.

(Thought experiment: Pascal, for instance, is plainly meant to be read by humans. Might someone claim exemption from infringement after merely translating Pascal code, line by line, into C, a process so straightforward it's been automated? In 1978, a judge named Higginbotham ruled that no, someone couldn't. He even said it would "probably" be a violation to translate a flowchart into a computer language.)

Apple carried Judge Newcomer's ruling to the Court of Appeals, where on August 30, 1983, Judge Dolores K. Sloviter upheld Apple. She brushed aside what had given Judge Newcomer pause, the question whether a machine or a person was the destined reader of the code. Utilitarian? Aesthetic? The Copyright Act, she held, did not distinguish. What she did zero in on was whether Franklin could have simulated the Apple operating system without copying it line by line; for if idea and expression merge, Apple has no valid copyright, because that would amount to copyrighting an idea, which can't be done.

The line between the two, she said, must be "pragmatic," legalese for "what follows is a hunch." For "many of the courts which have sought to draw the line between idea and expression have found difficulty in articulating where it falls." Judge Sloviter wasn't presented with a case of "not copying except where necessary," hence didn't decide such a case. She was presented with a case of line-for-line copying, and Apple and Franklin took her hint to settle out of court. So "except where necessary" remains undefined, likely only addressable, says Clapes, "on a case-to-case basis." Case by case, though, *Apple* v. *Franklin* won't go away.

For here's another nugget from Judge Sloviter. There may be, as Franklin alleged, only a limited number of ways to write an Apple-clone operating system. Fine, that says there's more than one, so over at Apple idea and expression haven't merged, and copyright holds. But if Franklin got hemmed in by its desire for a clone that would run *all* available Apple software, that was "a commercial and competitive decision," and they should have had the wit to scale it down.

(Analogy, from me, not from Clapes: If you want a script that will produce in a theater *exactly* the effect of Shakespeare's *Hamlet*, then you've no recourse save to copy out Shakespeare's *Hamlet*. But you've made a commercial, not an artistic, decision. On the other hand, Tom Stoppard's *Rosencrantz and Guildenstern Are Dead*, though arguably parasitic on *Hamlet*, is a piece of artistry that infringes nothing.)

And Clapes argues throughout that programs "are literary works," and "not just in a copyright sense but as a matter of social taxonomy." They are literary works "in the way that a musical score or the 'shooting script' of a movie are literary works: One doesn't read them through like a novel, but they have the attributes common to all literary works." These include "structure, flow, logic, design, naming conventions, commentary, and resultant style."

Which brings us to look and feel, which apparently derives from the phrase "total concept and feel" in "a twenty-year-old case involving the copying of thematic and stylistic features of a line of greeting cards." The dashboard analogy has been popular lately; if you can drive one car you can drive them all, because controls and gauges are in pretty well standard locations. Judge Higginbotham even alleged 12 years ago that the gearshift *H*-pattern was "idea," not "expression," and hence not protected at all.

But the law doesn't work (as I've noted) from absolutes like the *H*-pattern gearshift or the velocity of light; it works tortuously, through a maze of decided cases, and chapter 20 of Clapes' book ("The 'Look and Feel' Cases") brings no easy comfort. Look-and-feel defendants will be spared liability "if, when everything is eliminated except the expression that may not be copied in the plaintiffs' user interfaces, it is found that they have not copied that expression." That seems to mean, if you take away everything except what looks like an elephant, and the elephant wasn't really copied, you're clear. Lawyer Clapes will perhaps forgive me if I say that the progress toward such a finding resembles the passage of a ball through a pinball machine (bounce, bounce; left? right? What did Judge A make of question X? Judge B of question Y?).

The man who stood up after a Clapes presentation to say "I disagree with everything you say" was understandably impatient. Your right in what you're doing seems very clear as you program. But you program out in a world where other programmers have been weaving trails that their employers may have protected. "Because the look and feel of a program is the part with which the user most clearly identifies, and the part that cannot be hidden from competitors, there would be absolutely no point in the development of innovative user interfaces if the results of those investments could be freely copied by others."

True. But the dashboard analogy? Is it simply that no one thought to sue when clutch left, brake right—the *H*-pattern for that matter—got copied and recopied? I've not been able to find a historian of these automotive matters. Clapes, I may as well tell you, is "a Senior Corporate Counsel at IBM," although he's careful to deny giving things an IBM slant. What his book clarifies is why court decisions are not intuitive, the way programmers would like them to be. Law works its uneasy way through precedent, precedent. *Software, Copyright, and Competition* may, at the very least, teach us all patience. ■

Hugh Kenner is a professor of English at Johns Hopkins University. His reviews have appeared in publications like the New York Times *and* Harper's. *His recent books include* A Sinking Island *and* Mazes. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

They Left out Features....
We Left out the COMMA!!

The only thing missing...

is the comma in the price. If you look at the chart on the right you will see prices charged by our competition. All but one contain a comma. DesignCAD 3D sells for $399.00. Period. No Comma!

AutoCAD rel. 10	$3,000.00	AutoCAD AEC $1,000.00 AutoShade $500.00
CADKEY 3.12	$3,195.00	Solids $995.00 IGES translator $1,995.00
DataCAD with DC Modeler	$3,990.00	DataCAD Velocity $2,000.00
DesignCAD 3D ver. 2.0	**$399.00**	**NO expensive options! IGES Free, Shading Free**
MaxxiCAD 1.02	$1,895.00	N/A
Mega Model	$995.00	MegaDraw $195, List $295, MegaShade $395
MicroStation PC 3.0	$3,300.00	Customer Support Libraries $1,000.00
ModelMate Plus 2.8	$1,495.00	N/A
VersaCAD Design 5.4	$2,995.00	N/A

Source: Byte Magazine

In order to draw the complex pictures shown below it is desirable to have the following 3D features:

- **Interactive design with 3D cursor**
- **Blending of surfaces**
- **Boolean operations such as add, subtract, and intersection**
- **Complex extrusions**
- **Cross sectioning**
- **Block scaling**
- **On screen shading**
- **Shaded output to printers and plotters**

All of these competitors left out one or more of these desirable features in their standard package. They didn't forget the most horrible feature - the comma.

DesignCAD 3D offers **ALL** the listed features plus many more!

If DesignCAD 3D has the power to create the 3D objects shown below, imagine how it could help with your design project!

DesignCAD 3D sells for $399. We left out the comma. We didn't think you would mind!

PC MAGAZINE SAYS...

DesignCAD 3D, the latest feature-packed, low-cost CADD package from American Small Business Computers, delivers more bang per buck than any of its low-cost competitors and threatens programs costing ten times as much. For a low-cost, self-contained 3D package... DesignCAD's range of features steals the show."

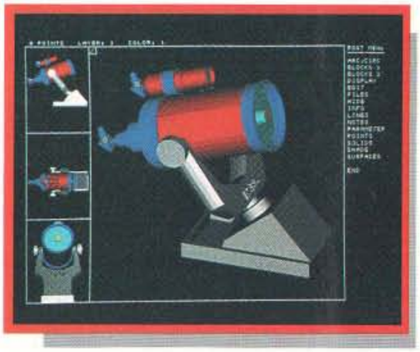
$399

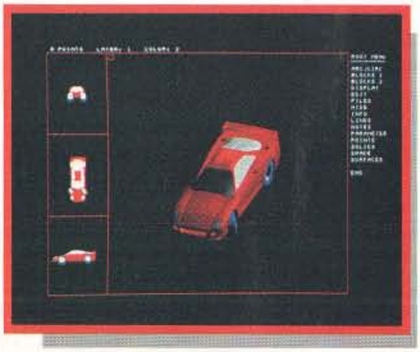
BYTE MAGAZINE SAYS...

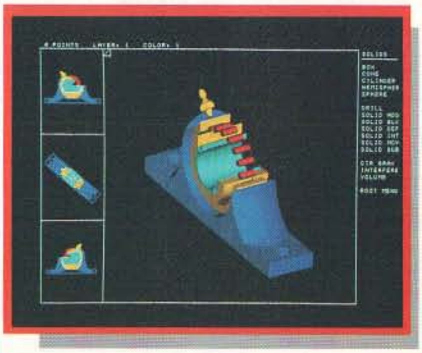
"At $399, DesignCAD 3D was the least expensive package we saw, yet it was one of the more powerful. ..Don't be fooled by the remarkably low price, this program can really perform."

May 1989, page 178

Complete 3-Dimensional design features make it easy for you to construct realistic 3-D models. With full solid-object modeling capabilities you can analyze your drawing to determine the volume, surface area or even center of gravity! DesignCAD 3-D even permits you to check for interference between objects! Aeronautical Engineers can now find the center of gravity for a new airplane design with a couple of keystrokes. The Architect can determine the surface area of a roof for decking in a matter of minutes. The Civil Engineer can calculate the volume of a lake or dam in seconds. The Mechanical Engineer will know for sure if certain parts fit together without interference. The uses for DesignCAD 3-D are only limited by YOUR imagination!







HOW DO I GET ONE?

DesignCAD 3-D and DesignCAD 2D are available from most retail computer stores, or you may order directly from us. If you have questions about which program to purchase please give us a call. All you need to run DesignCAD 3-D is an IBM PC or compatible computer with 640 K RAM memory and a hard disk. Both products support most graphics cards, printers, plotters and digitizers. Free Information and a demo disk are available by faxing (918) 825-6359 or telephoning:

1-(918) 825-4844

American Small Business Computers • 327 South Mill Street • Pryor, OK 74361 U.S.A.

Circle 307 on Reader Service Card (DEALERS: 308)

TO BOLDLY BENCHMARK

A giant leap in our 15-year mission to seek out new means of testing computers

Over the years, BYTE has pioneered the use of benchmark tests as a means of evaluating which computer system is right for you. Just last month, we rolled out our latest suite of benchmarks, designed to test and compare Unix-based systems.

But our most exciting project to date is one that could change forever the way benchmark tests are conducted. Until now, security precautions and the sensitive nature of the project have prevented us from discussing it. However, starting in September, with our fifteenth anniversary issue, BYTE will add an entirely new suite of tests to its benchmark series.

The Final Frontier

In the days to come, exploiting new opportunities in space will become increasingly important to maintaining our economic position in the marketplace. Computers will become an even greater part of business and technology. But present-day tests are useless for evaluating the kinds of conditions under which computers in space will have to operate.

To address these new considerations, we've designed a series of tests to be conducted on each new system reviewed in BYTE. Beginning in September, we'll report the results of the tests, which will be carried out through a special arrangement with mission specialists on regular flights of NASA's space shuttle. Developed with the assistance of Dr. Thomas Fulery of the Wisconsin Institute of Technology, the tests will subject review systems to conditions that we can expect to be operating under in the days ahead.

Stop Bit is an open forum for informed opinion on topics related to personal computing. The opinions expressed are those of the author and not necessarily those of BYTE or its staff. Your contributions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

The Tests

As we venture farther into space, we may find that gravity is a luxury that we can't always afford. How will this affect your new computer's ability to perform sensitive calculations? To test this, the BYTE *nul-grav* benchmark will measure a system's ability to perform floating-point operations in a zero-gravity environment.

The *hatch-activation-loop* test will measure each system's ability to perform extensive repetitions of ordinary tasks. This HAL test will determine how many times the system can open and close the space shuttle's pod-bay doors in one hour and whether the system loses track of whether the door is open or closed.

Of course, not all computing will be done in a human-friendly environment. Thus, we have designed several benchmarks for extra-vehicular execution. The *totality-rad* test, for example, will measure the length of time that the review system can withstand exposure to cosmic radiation without producing computation errors.

Another extra-vehicular test will analyze a system's susceptibility to stresses and strains caused by breeches of security that might affect its operation and thereby present a threat to life-support systems. Based on our now-classic Sieve of Eratosthenes benchmark, the *Strain of Andromeda* test (named for the mythical goddess who was rescued from a monster) will analyze systems for possible infection by computer viruses.

During the (of necessity) final benchmark test, the review system will be ejected from the shuttle and allowed to reenter the earth's atmosphere. For this *burn-in* test, each unit will be equipped with a radio-transmitter modem and will transmit signals back to earth, where BYTE editors will record the exact time and height at which the system ceases to operate. Any system that continues to operate until it reaches the ground will automatically receive a BYTE Award of Excellence for endurance.

On the outside chance that a review system might spin off into space rather than come back to earth, we have written the new benchmark tests in BASIC. In the unlikely event that the system is intercepted by extraterrestrial life forms, we believe that BASIC is the language most likely to run on any given alien system.

Now It Can Be Told

As you might expect, developing the new BYTE benchmarks has required months of negotiation with the administration of our nation's space program. Unknown to the general public, the most recent flight of the space shuttle carried a preliminary test machine on which shuttle personnel conducted the new BYTE benchmarks. According to mission specialist Irving M. Kidden, the tests were almost a complete success. "The only problem came when one of the guys was making some Tang during the nul-grav test," he said. "Some of the powder got into the disk drive and really gummed up the works." This mishap, however, provided an opportunity for the new benchmarks to display their user-friendly, plain-English system of error messages: The affected machine promptly displayed the message, "He's dead, Jim."

It is with great pleasure that we announce the new BYTE On-Going Utility in Space tests. For more information on our new benchmarks or to receive a copy for your own use, please see the box on page 343. ■

Kenneth M. Sheldon is a BYTE senior technical editor. He can be reached on BIX as "ksheldon."

Tandy® Business Systems

Step up to power planning.

What the future holds is in your hands . . . today. With a 386™-based Tandy Business System, you'll have the power you need to set—and reach—your strategic objectives.

Quickly transform raw data into useful information. Compile a spreadsheet to compare current and previous figures, then graph the results to see once-hidden trends.

Pinpoint those areas needing improvement, outline your plan and create PERT charts to support your formal proposal.

You won't be charting your course alone—Radio Shack offers the best support services in the industry.

Success? Plan on it with a Tandy Business System.

Radio Shack® COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

386/TM licensed from Intel Corp.

Circle 242 on Reader Service Card